USDA

United States Department of Agriculture

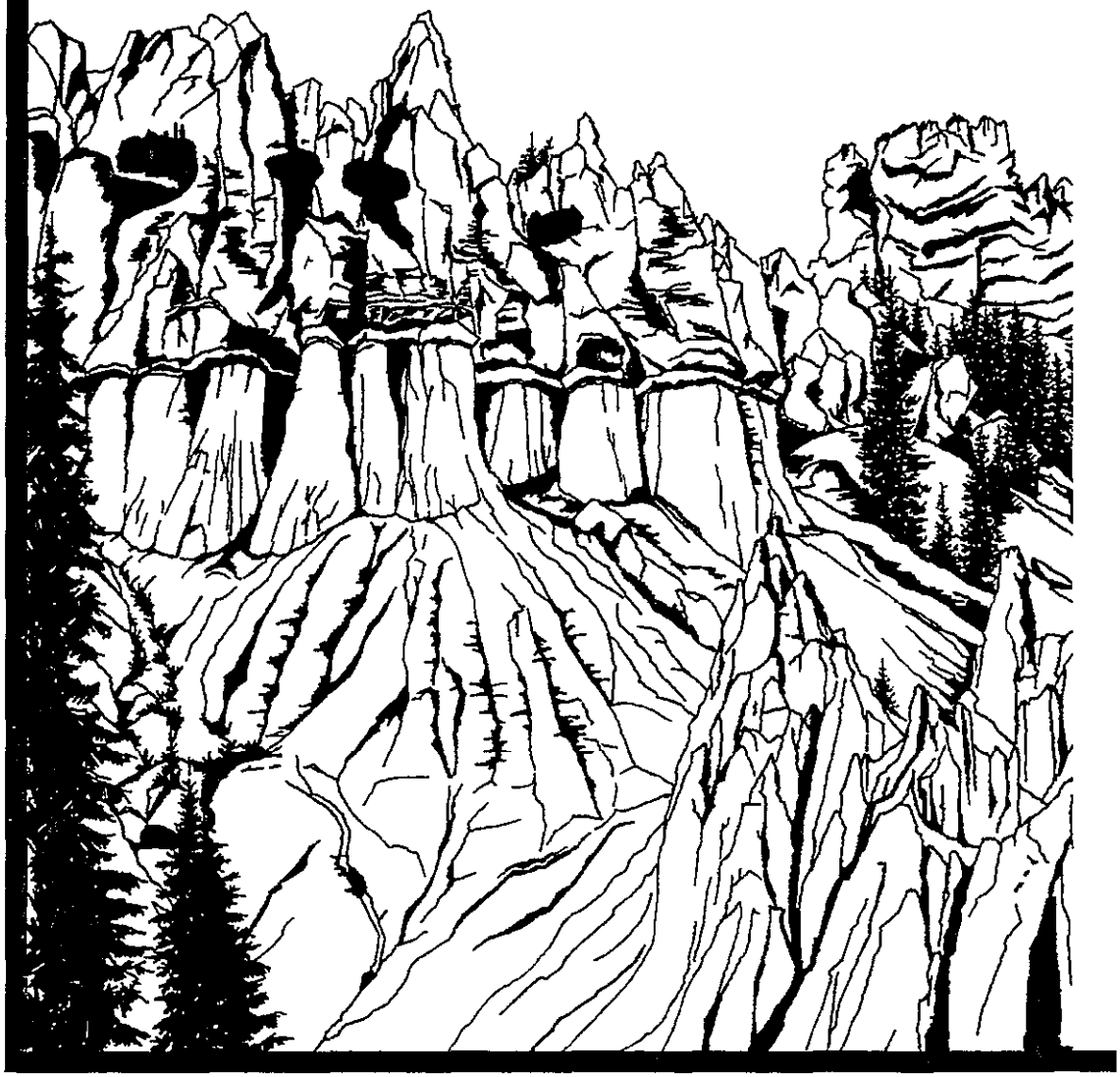
Forest Service

Rocky Mountain Region

Rio Grande National Forest

Final Environmental Impact Statement

For the Revised Land and Resource Management Plan



Rio Grande National Forest

Acknowledgments

We would like to acknowledge some folks that have played a very important role in the development of the Final Revised Forest Plan for the Rio Grande National Forest All too easily the efforts of those who have retired or moved to other positions is overlooked in the rush to get the job done. These people played a key role and we want to say thanks

Tom Lonberger - Tom was the Forest Planning Staff Officer until he retired a couple of years ago. Tom is responsible for getting this planning effort off the ground and for developing some of the initial strategies for both the plan and the public involvement strategy that we used. Tom's experience, wisdom, and counsel has stayed with us as we bring the process to conclusion We are told that Tom is heavily involved in various Community Service activities and doing a lot of fishing. We are told too, that he is often seen smiling.

Charles Keller - Charles was the Forest Engineering Staff Officer until he retired a couple of years ago. Charles was a key player in the formulation of our strategy to portray Travel Management and the Infrastructure portion of the Revised Forest Plan His experience and leadership were a real asset as we got the process off the ground Charles is Engineering a couple of circles not too far from Monte Vista He looks very happy whenever he is seen around town. There must be something special about working for yourself

John Bethke - John was a member of the Core Planning Group until he retired a couple of years ago He was one of those guys that works behind the scenes and didn't get much visibility. John was responsible for the Forest Vegetation Simulation model that we used for our growth and yield predictions in the Timber component of the Forest Plan Revision John is living in Monte Vista and we are told that his sense of humor is intact

Pam Wilson - Pam was a member of the Core Planning Group working as the writer-editor until she transferred a little more than a year ago She now works as an Information Specialist at our Supervisors Office in Durango Pam was responsible for the writing and the format of the Draft documents Pam's work carried over to the Final Our work was so much less complicated thanks to all the format work she did We appreciate that Pam

The Troops - That is, every single person who works on the Rio Grande National Forest Each and every one of you was called on at one time or another to help in some kind of way The Revised Forest Plan is the culmination of all of your patience, support, and hard work Thanks.

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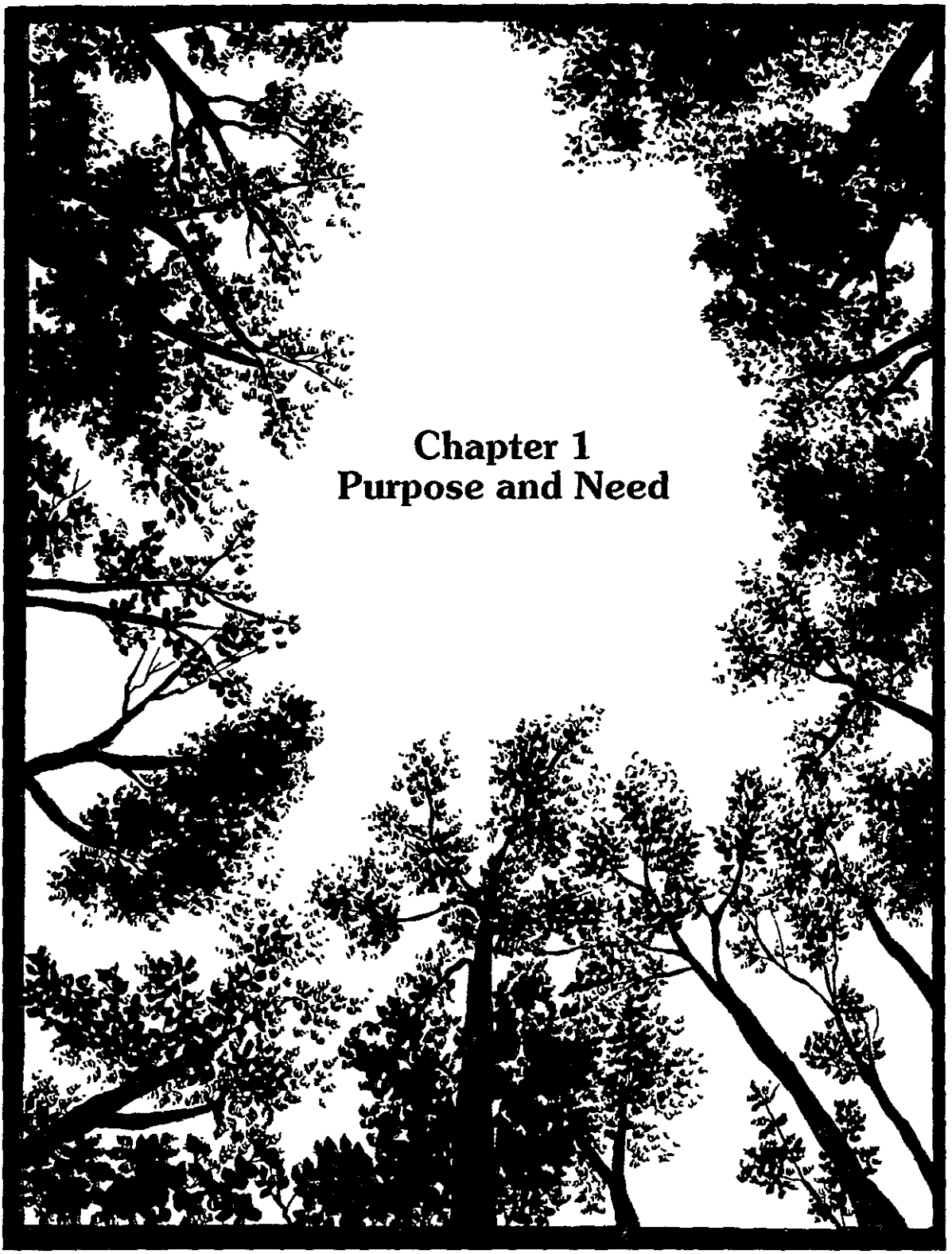

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Purpose and Need

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Chapter One

Purpose, Need and Significant Issues

THE PURPOSE OF AND NEED FOR ACTION

The fundamental purpose of this proposed action is to produce a Revised Forest Land and Resource Management Plan (Forest Plan) that will provide direction for the management of the Rio Grande National Forest (RGNF) and insure that management is in conformance with federal law, regulations, and policy The current Forest Plan for the RGNF was approved on January 4, 1985 As of June 1, 1995, there have been eleven amendments to the existing Forest Plan A revision of the Forest Plan is needed to satisfy regulatory requirements and address new information about the Forest and its uses

NEED TO CHANGE AND RATIONALE

The regulations implementing the National Forest Management Act (NFMA) require that Forest Plans be revised every ten years, and that the Forest Service explain why the revision needs to be done This section describes why the Forest Plan is being changed and the basis for the changes within the context of the regulatory requirements.

The instructions to revise Forest Plans and the basis for revision are found in the 1982 Code of Federal Regulations (CFR) at 36 CFR 219 10(g)

> Stated simply, the regulations require that the Forest Plan be revised on a 10-year cycle or at least every 15 years A Forest Plan can be revised at any time, and Forest Supervisors are required to review the conditions on the land covered by the Plan at least every 5 years to determine whether conditions or demands of the public have changed significantly

In the case of our current Forest Plan, almost ten years have passed since its publication, and public attitudes and issues have changed significantly In addition, U S District Court Judge Sherman Finesilver issued a decision (hereafter called Finesilver's Decision) in August 1989 that directed the RGNF to do additional analysis and discussion of several topics in the Plan and EIS

The Forest Plan is being revised as directed by the National Forest Management Act, the 1982 regulations cited above (36 CFR 219), and the Forest Service directive system (FSM 1909 12) In addition to these requirements, the Revision is also responsive to Finesilver's decisions, and the need for the Forest to conduct an oil and gas leasing analysis

Finesilver's Decision directed additional work on the subjects of suitable timberlands, economic and financial efficiency, and noted compliance with the Clean Water Act This effort was expected to be costly (about $400,000 00) and time consuming (an estimated 18 months), and would likely result in the need for a significant amendment to the 1985 Plan, if not a revision The oil and gas leasing analysis would have similar results

Next, the Forest conducted an information needs assessment (INA) aimed at improving the Forest resource database The assessment brought many new issues to light that warranted management consideration, and had the potential for amendments to the Plan Last, the 1985-1991 Forest Plan Monitoring Report (Monitoring Report) was completed The report indicated that 23 potential amendments were needed relating to management direction, and an additional 18 amendments relating to monitoring needed consideration

In the meantime, there has been a dramatic shift in the public's perception of Forest management There has been considerable concern expressed over the amount and type of timber harvest done on National Forests nationwide The subject of biological diversity (plant and animal systems) has become increasingly important. Relatively new concerns aabout management concepts involving habitat connectivity, island biogeography, species dispersal, old growth, old- growth patch size, and edge relationships represent just the tip of the biological iceberg

Older, familiar issues are still with us, but have taken on some new wrinkles For instance, the roadless-area issue that used to revolve around Wilderness designation is now central to concerns for things like biological diversity and human spirituality. The public is very well educated, aware of, and concerned about the health and quality of Forest ecosystems.

On the other hand, human needs are equally important Many people are concerned about perceived changes in Forest management that may affect their lifestyle Issues related to rural economic development, grazing, timber harvest, recreation, mineral development, jobs, economic stability, access (both to and through the Forest, and to public facilities), education, interpretation, and multiple use continue to concern many people, especially in local communities. These people are equally well educated, aware of, and concerned about the human dimension of Forest management

As we got into the public-involvement process, it became more and more apparent that we needed to develop a set of alternatives that are based solely on the resolution of issues and concerns raised by the public We did that, and we are confident that this is one of the real strengths of the alternatives In the past, alternatives were developed based on pre-determined targets (outputs) that were thought to define a range adequately Often, the concerns of the public were overlooked in the alternative development process The set of alternatives developed for this Plan Revision are based on a range of concerns derived from the public meetings

Based on all of this, the need for a revision of the Forest Plan is clear The decision was made to revise the Forest Plan based on

- ✔ Finesilver's Decision (U S District Court, District of Colorado, Civil Action 87-F-1714)
- ✔ Timber outputs versus Standards and Guidelines
- ✔ Issues brought to light during the information needs assessment
- ✔ Consideration of potential Forest Plan amendments resulting from the 1985-1991 Monitoring Report

✔ Changes in the public's perceptions of, and concerns about, Forest management

When the process began, we thought that parts of the 1985 Forest Plan could be revised and others would remain unchanged As time went by, it became apparent to all involved that the entire Plan would need to be revised, based on a lot of factors For instance, scientific knowledge of the physical and biological processes occurring on the Forest has improved dramatically over the last ten years, and continues to evolve. Forest personnel have a better understanding of this information and how it applies to natural resource management They also have a better understanding of the limitations and capabilities of natural resources and their processes Newly created or changed laws and policies affect Forest Plan content and Forest management For instance, the Forest must make decisions concerning the eligibility of potential Wild and Scenic Rivers, the availability of lands for oil and gas leasing, and the suitability of potential Wilderness lands to be recommended to Congress All of this ripples through the 1985 Forest Plan and, in effect, changes everything in it

COLLABORATIVE PLANNING / PUBLIC INVOLVEMENT

Initially, issues and concerns were identified by the Planning staff after reviewing environmental documents on file, letters from the public, and conversations with other Forest personnel These issues were taken to the public and built upon Eventually they evolved into the Revision Topics

An initial set of public meetings was held in the four towns where Ranger District offices were located and at Chama, New Mexico From these meetings, four public work groups (the people from Chama and La Jara went into one group) were chosen by the public to represent various National Forest users These groups have met a total of 26 times, including nine field trips. They helped identify issues, brainstorm possible solutions to issues, and develop a preliminary range of alternative themes The public at large has been kept informed of the Forest Plan Revision process through a series of newsletters and news releases Our mailing.list includes more than 1,500 persons and organizations

Public involvement and issue identification were carried on throughout Colorado at a series of 18 public meetings from November 1993 to January 1994 The preliminary alternatives and Revision Topics were presented at meetings in Denver, Boulder, Salida, Saguache, Monte Vista (three meetings), La Jara, Alamosa, Antonito, Chama, Durango, Pagosa Springs, South Fork, Creede, Del Norte, and Center. Over 600 individuals attended the meetings Discussions were lively, opinions diverse, and the level of interest in the Forest Plan Revision high There was significant comment on the range of alternatives, and they were revised accordingly Additional meetings have been held on request Another series of meetings was held in the fall and winter of 1995, following the publication of the Draft Environmental Impact Statement The purpose of these meeting was to answer questions about the preferred alternative identified in the Draft documents To date, the Forest Planning staff have participated in over 100 public or work group meetings, and the process will continue as this Plan is implemented

Forest Planning staff have coordinated with other Federal agencies (the Bureau of Land Management, National Park Service and US Fish and Wildlife Service) and various state agencies, including the Department of Natural Resources and the Colorado Division of

Wildlife. Staff also coordinated with or requested reviews from the Rocky Mountain Forest and Experiment Station and various colleges, including the University of Wyoming, the University of Colorado at Boulder, and Ft. Lewis College in Durango

A special effort has been made to contact Hispanic people, who comprise almost 50 % of the San Luis Valley population Most Hispanic-owned businesses are on the mailing list Roman Catholic priests throughout the San Luis Valley have been contacted to find key Hispanic persons to include on the mailing list After a newspaper article soliciting Hispanic involvement, two meetings were held with Hispanic groups in Monte Vista and Center, Colorado.

Another special effort has been made to establish a mutual and beneficial partnership with American Indians The purpose of this effort was to gain understanding of each other, honor American Indian treaty rights; be sensitive to traditional religious beliefs and customs; and provide research, technology, and other technical assistance to American Indian governments

To carry out these partnerships, four councils were established in the Rocky Mountain Region The Southwest Council group consists of representatives from the Hopi, the Jicarilla Apache, the All-Indian Pueblo Council, the Navajo, the Southern Ute, the Uinta and Ouray Ute, and the Ute Mountain Ute. This Council is working with the San Juan and Rio Grande National Forests Representatives of the Intermountain and Southwest Regions(3 and 4) of the Forest Service, and other federal agencies, attend meetings regularly, though they are not official members of the Council

After the publication of the Draft Environmental Impact Statement and Draft Forest Plan, there was a 120-day public-comment period The Forest received some 800 individual letters containing about 5,000 individual comments on the Draft Plan. Forest Staff read and responded to each of these comments, and numerous changes have been made based on them and incorporated into this Final Environmental Impact Statement and Revised Forest Plan

Public involvement/collaboration is ongoing The RGNF subscribes to the philosophy of "fish bowl" planning There are no secrets, and the door is always open to those interested in coming in to talk The Forest Planning process is subject to the requirements of the Federal Advisory Committee Act The Act requires that the public, across the board, be given equal opportunity to comment on the Plan and the process The RGNF Planning Staff is listening to all points of view and is really looking for and paying attention to good ideas The Forest Service retains the responsibility for the analysis of the alternatives, and for the identification of a selected alternative.

REVISION TOPICS

Revision Topics are generally regarded as subjects for which resource conditions, technical knowledge, or public perception of resource management have created a "need for change." These topics by themselves would generally result in a significant amendment of the Forest Plan because their resolution could change management direction over large areas of the Forest, the mix of goods and services that the Forest provides, and other decisions made in Forest planning The topics may involve choices in management direction

where there is no public consensus on the best course of action The Forest has identified five revision topics

1 Biological Diversity
2 Timber Suitability and Management
3 Wilderness, Unroaded, and Other Special Area Considerations
4 Recreation Opportunities and Travel Management
5 Oil and Gas Leasing

The Revision Topics can be thought of as "umbrellas" for several important issues related to the same revision topic. For instance, Biological Diversity covers issues such as riparian areas, habitat connectivity, old growth, Threatened and Endangered species, and so on The revision topics and their related issues are discussed in greater detail later in this chapter As stated previously, these are not the only things addressed in the Plan, but they are the most substantial and widespread.

The Revision Topics are described in detail below

1. Biological Diversity

Biological diversity (biodiversity) refers to "the full variety of life in an area, including the ecosystem, plant and animal communities, species and genes, and the processes through which individual organisms interact with one another and with their environment" (USDA Forest Service 1991) "Biodiversity at larger geographic scales, such as watersheds, landscapes, and beyond, includes the diversity of human cultures and lifestyles" (Salwasser et al 1993) Biodiversity occurs at many different levels, which can range from the molecular scale to complete ecosystems Therefore, the term comprises the relative abundance of genes, species, and ecosystems (Office of Technology Assessment 1987)

Essentially, biodiversity refers to the relative frequency and number of biological entities at a given spatial scale Wilson (1988) estimates that, though there are 1 4 million plant and animal species named and documented on earth, there may be as many as 5-30 million total species Consequently, just from a species-cataloging viewpoint, biodiversity is enormously complex Because of the complexity, there is no widespread agreement on how to measure it, or how best to perpetuate it Herein lie the controversy and polarity of opinion on how best to conserve biodiversity However, there is agreement that reducing the number of biological entities in a system reduces diversity (Langner and Flather 1994) The judgment of whether this is good or bad depends on individual human values

Increasing public awareness of biodiversity probably can be attributed to several global trends These are accelerated extinction rates and accelerated habitat loss and fragmentation (Plescher and Hutto 1991, Noss and Cooperrider 1994) These changes are especially dramatic in the tropics, but are occurring in the temperate regions of the world as well These global trends have focused local concern for biodiversity on public lands, and heightened scrutiny of public-land management

There are many benefits to conserving biodiversity A diverse landscape provides recreation, aesthetic and spiritual appreciation, and products with tangible benefits to humans Though much of the biodiversity is invisible to people, it is essential to ecosystem health and

sustainability All species serve a role in the environment, whether humans perceive their value or not Only a few species have been evaluated for their usefulness to humans All food and 75% of medicines come from wild species Only a fraction of the existing species are actually used by humans (Hoffmann, 1991)

The 1985 Forest Plan reflects an effort to comply with the many laws and regulations that covered the issues of that time Because some Standards or Guidelines were so broad or non-specific about an action, however, there was no way to ensure compliance Developing specific methods for the management of biodiversity and the monitoring of management activities will improve the Forest Plan

The direction in the 1985 Forest Plan is insufficient for today's concern about biodiversity The direction does not focus on the "whole" of an ecosystem, it focuses on the "parts " While those parts (i.e , diversity standards for the entire Forest) were the focus of that time, they may be expanded now to include additional parts (i e , diversity standards for the Forest at landscape, community, and species levels) Expanding to the different levels may help us to see the whole ecosystem picture The 1985 Forest Plan tended to take a smaller-scale view instead of the larger (landscape) view of the Forest It was also rare that past actions, or the historical "part" of impacts were included in cumulative-effects analysis The 1985 Forest Plan attempted to provide direction for some components of biodiversity (composition, structure, and function), but focused mainly on those that were economically important

Finally, the Forest Service's management philosophy, known as ecosystem management, has changed to one of managing multiple uses within the context of a broad assessment of all resource, social, and economic values This approach to management can better adapt to growing concerns related to the following: (1) biodiversity, (2) old-growth forests, (3) riparian areas, (4) Threatened, Endangered and Sensitive species, (5) suitable rangelands; (6) aspen perpetuation, (7) water quality, (8) air quality, (9) access, as related to human effects on ecosystems; and (10) wildlife and fisheries habitat

A critical element of ecosystem management is providing for the perpetuation of natural landscape diversity (composition, structure, and function). This includes consideration within a spatial context (what species, what kind of stand structure, and what kind of landscape patterns are natural by ecosystem?) and a temporal context (which seral stages and how much are natural by ecosystem?)

These are complex and difficult questions to answer A biodiversity assessment was conducted and it attempted to evaluate key attributes of the environment The assessment consisted of the following evaluations.

1 Fine-filter assessment–an evaluation (fine resolution) of rare plants, animals, and plant communities over several spatial scales

2 Coarse-filter assessment–an evaluation (coarse resolution) of broad habitat conditions for composition, structure, and function over several spatial scales

3 Range of Natural Variability assessment–a literature review of the historical evolution and use of the Forest's ecosystems

Collectively, these comprise a spatial and temporal evaluation of the biological diversity resources on or influencing the RGNF The assessment then goes on to describe the biological-diversity resources within the Forest boundary Key issues are fragmentation and connectivity; old-growth forests, Threatened, Endangered, and Sensitive species, and introduced species Finally, this leads into discussions of each resource's reaction to the proposed alternatives.

2. Timber Suitability and Management

This Revision Topic deals with all aspects of timber management and related issues. The topic focuses on which RGNF lands are suitable and scheduled for timber production, how much timber will be produced, and what kinds of harvest techniques will be used to produce timber

Finesilver's decision on the litigation of the 1985 Forest Plan required a reanalysis of suitable timberlands and allowable sale quantity (ASQ-How much timber can be sold each year) Other aspects of the decision include an economic analysis, the inclusion of a profitable-timber-production program alternative and the rationale for its selection or rejection, and the use of current price data in the analysis

Several timber-related issues have come to light In the last few years it has become increasingly difficult to produce a volume of timber that even approximates the ASQ identified in the Plan This has to do with discrepancies between the Standards and Guidelines (S&Gs) and the ASQ Consequently, the annual timber program has been decreasing, since S&Gs take precedence over outputs when conflicts occur

The 1985 Plan was modeled based on silvicultural prescriptions that have since been modified, or are no longer being used The Plan was modeled using predominantly even-aged prescriptions. More uneven-aged systems are now being used, because of landscape levels of analysis and the desire to emulate the scale, size, and distribution of disturbances that occur naturally in forest lancdscapes

Also, the Forest Plan Monitoring Report identified the need for at least two potential amendments related to timber management These amendments will be done as part of the Forest Plan Revision since they are related to the ASQ and the silvicultural practices that will be employed to produce timber

The public is very interested in a financially efficient timber program Concern centers on below-cost timber sales and the inefficiency of that approach Another facet of the issue is the local social and economic impacts of timber management

Finally, the Goals and Objectives for other resource areas are sometimes in conflict with the Goals and Objectives for the timber program These differences need to be resolved in light of the legal requirements that mandate the production of timber from National Forests

3. Potential Wilderness, Undeveloped Areas, and Other Special Area Considerations

This Revision Topic includes possible recommendation of areas for Wilderness designation by Congress, consideration of rivers and streams eligible for inclusion in the Wild, Scenic,

and Recreation River System (WS&R), consideration of areas for inclusion in the Research Natural Areas (RNAs) program; and consideration of other Special Areas for protected status. It also considers allocation of unroaded areas to non-development Management-Area Prescriptions, such as Backcountry

The Monitoring Report recommended two Forest Plan amendments related to Wilderness (1) updating some S&Gs for Wilderness, and (2) revising Management-Area Prescription allocations within some Wilderness Areas There has been considerable interest both locally and regionally in the disposition of the Forest's unroaded areas Many people are interested in leaving areas undeveloped without recommending them for Wilderness designation. They feel that Wilderness designation attracts use that would not otherwise occur. Others place high value on unroaded areas for their potential to protect biological diversity. Still others place a high value on the development of these areas for the production of timber or other natural resources.

Comments gathered since the 1985 Forest Plan indicate public interest in the study of rivers for possible inclusion in the WS&R system. The Forest has identified 13 rivers eligible for inclusion into the WS&R system The rivers are listed in Table 3-74 of the EIS

36 CFR 219 25 says that "Forest planning shall provide for the establishment of Research Natural Areas (RNA's) " There are no RNAs established on the Forest yet, but we have identified seven potential RNAs. The potential RNAs represent a variety of ecosystems in different landscape settings

Although Special Areas are not mentioned in the planning regulations, certain areas of the Forest, such as the John Charles Fremont Historical Area and the Blowout Pass Geological Area, often need special S&Gs for us to manage them adequately The Forest also has several areas with Forest Service-designated Sensitive plant species that are proposed for protection with the Special Interest Area designation in some alternatives.

4. Recreation and Travel Management

The Monitoring Report recommends several possible Forest Plan amendments related to recreation These include (1) updating the general dispersed-recreation direction and eliminating direction that no longer applies to developed recreation sites; (2) revising Guidelines for recreation site development, and (3) including direction for designated Scenic Byways

In the 1985 Forest Plan, Recreation Opportunity Spectrum (ROS) settings were addressed as goal statements found in Management-Area Prescriptions. There was no specific analysis outlining the best mix of ROS settings that should be provided to meet the public's needs There was no specific decision made that outlined the ROS setting for each area of the Forest. These decisions affect other multiple uses across the Forest and must be made in context with ecosystems to achieve the appropriate management emphasis.

The 1985 Forest Plan addressed Scenery Integrity Levels for each Management Area Prescription as levels that could not be exceeded Specific Scenic Integrity Levels were not assigned to Management Areas These decisions need to be made in association with all uses and ecosystems

Although travel management constraints have been applied by each Ranger District on the Forest, they remain one of the most controversial facets of current management In 1990 the Forest's Travel Management Plan and map were updated Road closures associated with the Forest's 1990 Travel Management Plan have increased the controversy Strong feelings have surfaced on both sides of the issue during public meetings held as part of the Forest Plan Revision

Another facet of the issue came to light during the public-comment period, and centered on access to trails in unroaded areas, and their designation as motorized or nonmotorized The issue is controversial and polarizing

Road and trail construction, reconstruction, and related standards depend on travel- and access-management decisions Although decisions about access and wildlife disturbance are made at the project level, these decisions are tiered to ROS settings and travel management opportunities

5. Oil and Gas Leasing

Oil and gas leasing is a concern to many people interested in the management of the RGNF. The oil and gas industries favor large acreages of available and authorized lands for lease, and feel that effects can be mitigated Other individuals see oil and gas development as a threat to biodiversity, recreation, and natural resources, these people would prefer little or no oil and gas development While very few leases ever have an oil well on them, the Region 2 Reasonable and Foreseeable Development Report estimates that as many as 23 wells could be drilled over the next 10 years (Holm and Dersch 1994) This potential activity, along with social and resource concerns, creates controversy, and challenges the Forest to find balances between oil and gas development and other resource management

Except those lands formally removed from mineral activities by Acts of Congress or by Executive Authority, the search for and production of minerals and energy resources is an authorized use of the National Forest It is Forest Service policy to provide for access to, and occupancy of, NFS lands for mineral resource activities The activities must be consistent with management objectives, and the rights granted through statutes, leases, licenses, and permits

In 1987, new legislation was passed regarding the leasing of Forest lands The Federal On-Shore Oil and Gas Leasing Reform Act gave new authority to the Forest Service in making leasing decisions Shortly after the Act was passed, the Office of General Counsel found many Forest Plans inadequate in their analysis of the cumulative effects of leasing As a result, those National Forests scheduled leasing analyses that would address cumulative effects The RGNF chose to analyze the cumulative effects of leasing as part of the Forest Plan Revision, which began in 1992.

The Bureau of Land Management (BLM) is a cooperating agency concerning oil and gas activities on the RGNF The subsurface mineral estate is managed by the BLM, while the Forest Service manages the surface resources The BLM Canon City District Office has agreed to participate in the Forest Plan Revision process so that agency concerns and opportunities may be properly addressed

The legal need for the environmental analysis is found in 36 CFR 228 102 This regulation requires a leasing analysis be conducted

THE PROPOSED ACTION

The Forest Service proposes to revise the 1985 Forest Plan in order to address the issues and concerns and the judicial, legal, and regulatory requirements described previously

The Notice of Intent to revise the Forest Plan was originally published in the Federal Register on June 7, 1990. A subsequent Notice of Intent was published in the Federal Register on September 8, 1994 The Federal Register was also used to announce the release of the Final Plan and EIS

DECISIONS MADE IN THE FOREST PLAN

The adoption of a Forest Plan establishes key decisions for the long-term management of a National Forest. These decisions include the establishment of·

* Forestwide multiple-use Goals and Objectives, including a description of the Desired Future Condition of the National Forest (36 CFR 219 11(b)),

* Forestwide management requirements (Standards and Guidelines), to fulfill the requirements of 16 USC 1604 (The National Forest Management Act) applying to future activities (resource integration requirements 36 CFR 219 13 to 219 27),

* Management Areas and Management-Area direction (Management-Area Prescriptions) that applies to future activities in those Management Areas (resource integration and minimum, specific, management requirements, 36 CFR 219 11 (c)),

* Lands administratively available for oil and gas leasing, and the stipulations that must be applied to specific lease areas (36 CFR 228.102(d));

* Lands the Bureau of Land Management is authorized to lease, subject to review (36 CFR 228 102 (e));

* Lands suitable for the production of timber (16 USC 1604(k) and 36 CFR 219 14), and

* Monitoring and evaluation requirements (36 CFR 219 11(d))

In addition, the decision to adopt a Forest Plan may recommend areas for Wilderness classification where 36 CFR 219 17(a) applies. No project-level decisions are being considered as part of this Revision

SIGNIFICANT ISSUES

The Revision Topics are essentially the same as significant issues Remember, the topics are like umbrellas that cover several issues or concerns related to the same subject Significant issues are defined by their context (local, regional, or national) and intensity (degree of

effect) The National Environmental Policy Act (NEPA) defines "significant issues" as significant matters that are bound up in the proposed action (Forest Plan) and in the choice the decision makers have to make between alternatives Significant issues may or may not be based on a lot of public concern, but usually they are

The focus of this Forest Plan Revision has remained on multiple-use objectives Each alternative emphasizes different land and resource uses, however, from those emphasized by the other alternatives As a result, each alternative emphasizes certain land and resource objectives while simultaneously de-emphasizing other land and resource use objectives These are what are known as the trade-offs between alternatives

Some people will find that the selected alternative will not completely resolve their concerns about Forest management. This has to do with the difficulties involved in making decisions that are aimed at some level of balance in the resolution of issues Controversy over the decisions is inevitable and expected The identification of the selected alternative is based on the resolution of the five Revision Topics All five of these topics are significant and address social, economic, and biological concerns expressed by the public.

Issues and Topics Raised but Not Within Forest Service Authority to Address

Several topics and issues raised by members of the public and other agencies are not addressed in the alternatives of this FEIS They are described in more detail in the Purpose and Need document which is on file at the Forest Supervisors Office in Monte Vista, Colorado These issues are not addressed in this document for several reasons

The topic or issue may have required a solution that is outside the scope of the decisions made in a Forest Plan As noted earlier, the scope of decisions made in a Forest Plan includes Forestwide Goals and Objectives, Standards and Guidelines, Management Areas and Prescriptions, the designation of land suitable for timber production, monitoring requirements, and Wilderness recommendations If the topic is not best resolved as one of those decisions, it is better handled in another process—either through changes in national or Regional policy, changes in the law, or decisions made by other agencies.

STAGED DECISION-MAKING

The Forest Plan Record of Decision, signed by the Regional Forester, has set a course of action for management of the RGNF for the next 10 to 15 years The adoption of a Forest Plan sets key decisions for the long-term management of a National Forest These decisions were described in a preceding section

However, environmental analysis will still need to occur for specific projects that carry out the direction in the Plan The best example of this is roads identified for closure. The Forest Plan contains the direction to pursue closure, but a site-specific analysis and decision will have to be made for each closure. This process is called "staged decision-making" because a series of decisions will be necessary to carry out projects as specific details, locations, and conditions become more apparent For example, a proposed wildlife habitat project using

prescribed fire would require additional environmental analysis to discuss the site-specific effects of the proposals (staged decision-making is a process upheld in U S District Court).

THE PLANNING, ENVIRONMENTAL—ANALYSIS, AND DECISION PROCESSES

Revision of a Forest Plan occurs in a number of steps Some of these steps, including the involvement of the public in exploring the need to change the Plan, the Analysis of the Management Situation (AMS), the publication of the Draft Environmental Impact Statement and Draft Plan, and the public-comment period, have already occurred Copies of the AMS, the DEIS, or information about specific analyses at any phase of the project can be obtained at the RGNF Supervisor's Office in Monte Vista, Colorado, though much of it is incorporated in this document. This Forest Plan is being revised using guidance in the 1992 Rocky Mountain Regional Guide.

This Final Environmental Impact Statement (FEIS) is available to the public. The Record of Decision is based on the information found in this document, and explains the rationale behind the identification of the selected alternative. This alternative will be implemented over the course of the next 10 - 15 years.

ORGANIZATION OF THE EIS AND REVISED FOREST PLAN

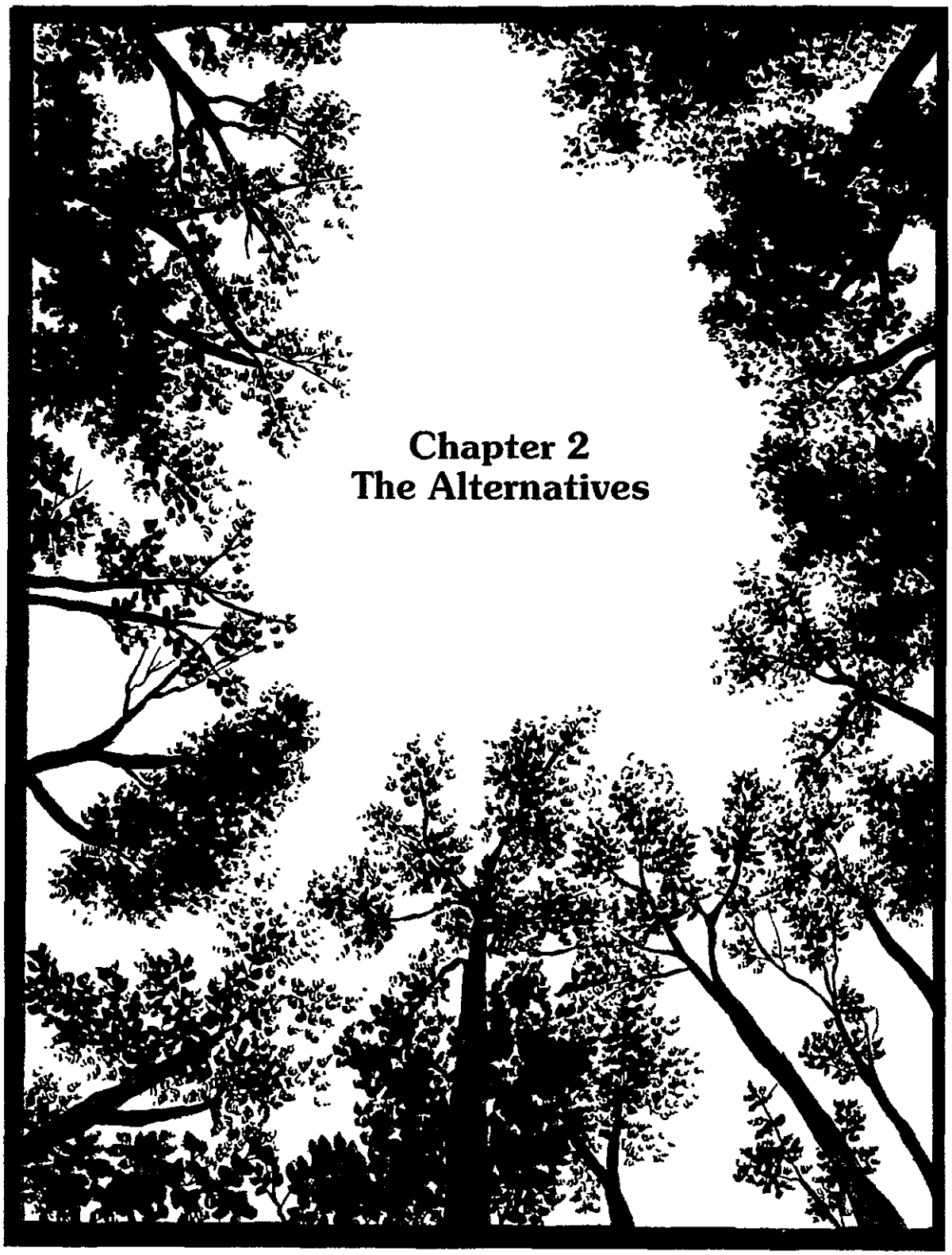
The Environmental Impact Statement is organized into a number of Chapters.

Chapter 1	contains the Purpose, Need and Significant Issues.
Chapter 2	contains the description and comparison of the alternatives
Chapter 3	describes the affected environment and the environmental consequences associated with implementing the alternatives.
Chapter 4	contains the List of Preparers and their backgrounds.
Chapter 5	lists the literature cited in the preparation of the EIS.

The Revised Forest Land and Resource Management Plan is also organized into a number of chapters

Chapter 1	contains the Forestwide Desired Conditions
Chapter 2	contains a description of the Forestwide Objectives
Chapter 3	contains the Forestwide Standards and Guidelines
Chapter 4	contains Management-Area Prescriptions.
Chapter 5	describes the Forest Monitoring and Evaluation Strategy.

The Forest has gone to great lengths to make both documents readable to the public Still, it is inevitable that we will use terminology unfamiliar to the reader or that may have different meanings depending on context For this reason, we included a glossary (Appendix M) so the reader can better understand the document



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The Alternatives

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Chapter 2

The Alternatives

INTRODUCTION

This Final Environmental Impact Statement (FEIS) explores the differences between several management options or alternatives The Forest Plan can be revised by altering all, or a portion, of the programmatic decisions that make up the Plan The purpose of this chapter is to describe and compare the range of alternatives considered during the revision of the Forest Plan

This Chapter includes a description of

* How each alternative was developed
* Each alternative
* Why an alternative(s) was considered but eliminated from detailed study
* The summary comparison of the alternatives

DEVELOPMENT OF THE ALTERNATIVES

As discussed in Chapter 1, this Revised Forest Plan is based on the need to change the 1985 Plan This concept is key to the formulation of alternatives. Certain portions of the Plan are the same in all of the proposed alternatives, including

* Existing Ski Areas
* Existing developed recreation sites, utility corridors, and electronic sites
* Designated Scenic Byways
* Current Designated Wildernesses

Potential major changes to the Forest Plan are identified as Revision Topics, which are based on significant issues identified since the existing Forest Plan was adopted in 1985 After identifying Revision Topics the Forest Plan interdisciplinary (ID) team, working with Public Work Groups, analyzed how well the current Plan responds to the topics As the need for change became apparent the team developed a set of options or alternatives based on the resolution of the Revision Topics In addition, the team identified less significant changes and looked at new ways to mitigate the effects

Because of the interrelationship of between the Revision Topics, the options for addressing each topic were combined into tentative alternatives These preliminary alternatives were derived based on the information in the Analysis of the Management Situation, July 1994 Further refining of the alternatives occurred based on alternative emphases or themes

developed by the Public Work Groups and the ID Team These alternatives were presented in a preliminary format at a series of Public Work Group and public meetings held in December 1993 and January 1994 in locations throughout Colorado and the San Luis Valley The public was asked to comment on the appropriateness of the range of alternatives, how well they addressed the Revision Topics, and whether additional alternatives were needed. A final iteration was done and the resulting alternatives are the ones analyzed in this FEIS

Each alternative is essentially a separate Forest Plan The alternatives address changes to each component of the existing Forest Plan Goals and Objectives, Standards and Guidelines, Management-Area allocations, Monitoring and Evaluation strategies, Allowable Sale Quantity, oil and gas leasing availability, recommendations for additions to the Wilderness system, and identification of eligible Wild and Scenic Rivers

The ID Team assembled alternatives that respond in different ways to the Revision Topics All of the alternatives were produced without any preconceived idea of what a preferred alternative might look like, nor any idea of what outputs might result All of the alternatives are workable and achievable

Important Points Concerning All Alternatives

All alternatives include the concepts of multiple use and ecosystem management All alternatives share a set of basic Goals and Standards and Guidelines that insure protection of forest resources (including biological diversity) and compliance with applicable laws

It is important to remember that the decisions made in the Forest Plan and described in Chapter 1 are very detailed and very complex The accompanying Forest Plan is designed to display those decisions

* Conclusions about the alternatives should not be drawn without reviewing the details in the Forest Plan and the analysis found in the Final Environmental Impact Statement

* All alternatives (including the current management alternative) use a new numbering scheme for management areas to be consistent with other Forests in this Region and surrounding Regions.

* All alternatives meet the management requirements of 36 CFR 219 17, and all other legal and regulatory requirements

Objectives Shared by All Alternatives

Management of the Rio Grande National Forest (RGNF) will meet the objectives established in the *Rocky Mountain Regional Guide* The alternatives described emphasize some objectives more than others. These objectives are to

* Protect the basic soil, air, and water resources

* Provide for multiple uses and sustainability in an environmentally acceptable manner

* Provide for a variety of life through management of ecosystems.

* Provide for scenic quality and a range of recreation opportunities that respond to our customers and local communities

* Emphasize cooperation with individuals, organizations, and other agencies in coordination of planning and project application

* Promote rural development opportunities

* In cooperation with other landowners, strive for improved land ownership and access patterns to the mutual benefit of both public and private landowners

* Improve the financial efficiency for all programs and projects

THE SELECTED ALTERNATIVE

The Regional Forester, the responsible official, has identified Alternative G as the selected alternative based on the analysis in this FEIS. The identification of this alternative is the final decision that selects the alternative that will be implemented over the course of the next 10 - 15 years The specific rationale for selecting this alternative is described in detail in the Record of Decision which is included in the Final Revised Forest Plan

DESCRIPTION OF EACH ALTERNATIVE

Alternative A

Background: This Alternative responds to several Revision Topics It also responds to the planning requirement (FSH 1909 12, Section 3 56) that one alternative recommends and analyzes all unroaded areas 5,000 acres and greater for Wilderness designation This Alternative provides significant additions to the Wilderness system, responds well to biological diversity, and provides a high level of nonmotorized recreation opportunities

Theme: Some people think that the best way to perpetuate ecosystems and forest health is with a "light touch". little human interaction and influence, emphasis on Wilderness and Backcountry with nonmotorized access, no new road construction, no suitable and scheduled timberlands and no Allowable Sale Quantity (ASQ), etc This Alternative emphasizes a "light touch" approach to forest management

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a relatively strong ecocentric perspective of the environment (i e , that humans are a part of the environment but are not central to all concerns). Large tracts of land are preserved through existing and recommended Wilderness allocations The intent of this Alternative is to allow ecological processes such as fire, insects, and disease to function with little influence from humans. Diversity, resulting from natural succession and

disturbances, is expected to predominate Management Prescriptions that place human uses subordinate to the natural environment are emphasized There will be no loss of species. Where management activities do occur, they are done with the intent of maintaining or restoring ecosystems—not with the intent of strictly providing resources for human use A combination of coarse- and fine-filter approaches to conserving biodiversity are employed to ensure sustainable ecosystems.

2 Timber Suitability and Management

There will be no lands designated suitable for timber management, nor scheduled for harvest As a result, this Alternative does not have an Allowable Sale Quantity Any harvesting of trees will be a result or by-product of other resource needs and projects, such as wildlife habitat improvement or opening vistas Cutting patterns will simulate natural disturbances, using even- or uneven-aged management across the entire range of silvicultural prescriptions, and fluctuate from year to year. Salvage/sanitation cutting will be allowed when meeting resource objectives other than commodity production Commodity outputs are expected to be low No timber road construction would occur. Availability of, and accessibility to, other forest products (fuelwood, posts/poles, Christmas trees, transplants) will be limited.

3 Wilderness, Undeveloped Areas and Other Special Area Considerations

All unroaded areas 5,000 acres and greater are recommended for inclusion into the National Wilderness Preservation System All undeveloped areas between 500 and 5,000 acres would remain undeveloped.

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System.

There are seven potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills Zone up through the Alpine Zone Two botanical Special Interest Areas are proposed, which give special recognition to Ripley milkvetch (*Astragalus ripleyi*) and rock-loving aletes (*Neoparrya lithophila*) There are also four geologic SIAs proposed

4. Recreation and Travel Management

Emphasis is on semi-primitive nonmotorized recreation within those areas proposed for Wilderness The developed recreation program will emphasize maintaining and rehabilitating existing developed facilities and developing new trailheads where needed The dispersed recreation program will capitalize on interpretive opportunities, and expand the Leave No Trace program

Travel management emphasis is on reducing the miles of road throughout the Forest that do not meet management objectives or are causing resource damage

5 Oil and Gas Leasing

All existing Wilderness and recommended Wilderness would be unavailable for leasing. The remaining lands would be closed to leasing by management direction No lands are administratively available or authorized for oil or gas leasing The BLM would not lease the interspersed tracts within the NF boundary Only one oil well might be expected and that would occur in the Chama Basin where the mineral estate is privately owned and the mineral potential is high for oil and gas resources

Alternative B

Background: This Alternative responds to several Revision Topics, and to concerns for the economic stability of communities in and around the San Luis Valley The most significant difference between this Alternative and the existing management plan is the increase in areas allocated to Backcountry Motorized and Nonmotorized Recreation

Theme: Some people feel that the best way to insure economic stability is by higher levels of timber harvest and the perpetuation of other programs, including recreation- and tourism-related programs, which provide monetary returns at the local and national level This Alternative emphasizes higher levels of timber and other resource production while incorporating the principles of ecosystem management. Other resource values such as recreation settings are maintained to insure the integrity of noncommodity resources that indirectly support the recreation and tourism related industries.

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a relatively strong anthropocentric perspective of the environment (i e , interpreting everything's worth based upon human experience and values) There is an emphasis on resource production within the limits of sustaining ecosystems Ecological processes, diversity, and productivity will be maintained naturally or artificially where human-valued outputs are desired A sustainable flow of products, services, and ecosystem values that are socially acceptable, economically viable, and within the biological capability of the resource will be provided We anticipate that species viability will be maintained Where habitat conditions are significantly outside the Range of Natural Variability (see EIS Appendix A), a program of ecosystem restoration will be started Use of a combination of coarse- and fine-filter approaches to conserving biodiversity will ensure sustainable ecosystems These approaches are explained in the Biological Diversity section in Chapter 3

2 Timber Suitability and Management

Timber management will emphasize sustainable production from the suitable land base within the natural range of variability Silvicultural prescriptions applied to suitable lands emphasize even-aged management Undeveloped areas may be entered Other forest products, like firewood, will be available and accessible

3 Wilderness, Undeveloped Areas and Other Special Area Considerations

This Alternative makes no Wilderness recommendations Development may occur in unroaded areas having high potential for timber production or oil and gas leasing All other unroaded areas will be managed to provide for semi-primitive motorized and nonmotorized recreation opportunities, with an emphasis on motorized access

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System

There are seven potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills Zone up through the Alpine Zone There are two botanical Special Interest Areas proposed, which give special recognition to Ripley milkvetch (*Astragalus ripleyi*) and rock-loving aletes (*Neoparrya lithophila*) Five other SIAs are proposed, three are for geologic areas and two for historic areas

4. Recreation and Travel Management

Recreation management emphasizes multi-season, multi-use programs The developed recreation program emphasizes rehabilitating and expanding existing developed facilities, besides developing new facilities where demand exists The dispersed recreation program will emphasize increased motorized opportunities while offering some opportunity for semi-primitive nonmotorized settings outside Wilderness Motorized recreation opportunities throughout the Forest will increase as new road construction and reconstruction occur.

Travel management will emphasize closure of those roads that are causing resource damage

5 Oil and Gas Leasing

All lands outside Wilderness are available and authorized for oil and gas leasing There are two lease options analyzed under this alternative One option is to lease lands with standard lease terms only This means no resource protection Stipulations are included in the lease, other than those included in the standard lease terms This option is the least restrictive to the oil and gas industry. The second option is to lease lands using standard lease terms and resource protection Stipulations On private surface/Federal minerals lands the BLM would lease lands using standard lease terms or with standard lease terms and resource protection Stipulations About 23 wells could occur over the next ten years

Alternative D

Background: This Alternative was developed in response to the Revision Topics and the concern that they are given an emphasis that maintains the focus of forest management on multiple resource objectives Program focus is similar to the 1985 Forest Plan, except the amount of area allocated to Backcountry Recreation prescriptions is greater Resource production is lower due to these allocations, and the incorporation of ecosystem management principles into project plans

Theme: Many people feel that the best way to manage the Forest is through an even blend of multiple resource uses and principles of ecosystem management. This Alternative emphasizes a multiple-use concept that uses a specific set of Management-Area Prescriptions to protect biological diversity and maintain or improve the economy and quality of life in and around the San Luis Valley.

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a relatively moderate anthropocentric perspective of the environment A mixture of resource products, services, and values is featured within the limits of sustaining ecosystems Ecological processes, diversity, and productivity will be maintained naturally or artificially where human-valued outputs are desired Emphasis is placed on balancing human uses that dominate and those that are subordinate to the natural environment The Alternative features a sustainable flow of products, services, and maintains ecosystem values that are socially acceptable, economically viable, and within the biological capability of the resources We anticipate that species viability will be maintained Where habitat conditions are significantly outside the Range of Natural Variability, a program of ecosystem restoration will be started Using a combination of coarse- and fine-filter approaches to conserving biodiversity will ensure sustainable ecosystems

2 Timber Suitability and Management

Timber on suitable lands is managed using a full range of even- and uneven-aged silvicultural prescriptions Cuttings will be designed to simulate natural disturbances to the landscape Road construction into undeveloped areas is expected Other forest products, like firewood, are expected to be both available and accessible

3 Wilderness, Undeveloped Areas, and other Special Areas Considerations

None of the Forest's unroaded areas are recommended for inclusion into the National Wilderness Preservation System. Many unroaded areas will be retained and managed to offer semi-primitive nonmotorized recreation opportunities, but some will be available for semi-primitive motorized recreation opportunities.

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System

There are seven potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills Zone up through the Alpine Zone Two botanical Special Interest Areas are proposed that give special recognition to Ripley milkvetch (*Astragalus ripleyi*) and rock-loving aletes (*Neoparrya lithophila*). There are also two geologic and two historic SIAs proposed

4 Recreation and Travel Management

Multi-season, multi-use opportunities are emphasized. The developed recreation program will emphasize rehabilitating existing developed facilities and constructing new trailheads and other new recreational facilities where demand exists The dispersed recreation

program will increase semi-primitive nonmotorized opportunities, and interpretative and educational opportunities Some motorized opportunities are offered.

Travel management emphasis is on reducing the miles of roads on the Forest that do not meet management objectives or are causing resource damage

5 Oil and Gas Leasing

Most of the legally available (non-Wilderness) lands are administratively available and authorized for leasing. Only eligible Wild Rivers are closed to leasing by management direction. On leased lands, resources are protected with Stipulations that mitigate impacts. The BLM would lease the private surface/Federal minerals lands with Stipulations About 23 wells could occur over the next ten years.

Alternative E

Background: This Alternative was developed in response to the Revision Topics and the concern that they are given an emphasis that maintains the focus of forest management on multiple resource objectives with little or no additional development of the forest. Program focus is similar to the 1985 Forest Plan except there is a greater amount of area allocated to Backcountry Recreation prescriptions. Resource production is lower because timber harvest is limited to those areas logged in the past, and the incorporation of ecosystem management principles into project plans.

Theme: Many people feel that the best way to manage the Forest is through an even *distribution of multiple resource uses managed within the capabilities of the Forest's* ecosystems (in areas of past development). This Alternative emphasizes a multiple-use approach designed to maintain or improve the economy and quality of life in and around the San Luis Valley

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a relatively moderate anthropocentric perspective of the environment. Recreation is emphasized within the limits of sustaining ecosystems. *Ecological processes, diversity, and productivity will be maintained naturally or artificially* where human valued outputs are desired A sustainable flow of products, services and ecosystem values that are socially acceptable, economically viable, and within the biological capability of the resource will be offered We anticipate that species viability will be maintained Where habitat conditions are significantly outside the Range of Natural Variability, a program of ecosystem restoration will be started. Using a combination of coarse- and fine-filter approaches to conserving biodiversity will ensure sustainable ecosystems.

2 Timber Management and Suitability

Suitable timber lands consist of previously harvested areas and areas outside inventoried unroaded areas Silvicultural prescriptions applied to suitable lands will be dominated by

uneven-aged management. No timber road construction is expected Availability of, and accessibility to, other forest products may be limited.

3 Wilderness, Undeveloped Areas, and Other Special Area Considerations

Selected unroaded areas are recommended for inclusion into the National Wilderness Preservation System The remainder will remain unroaded and managed to offer Backcountry Motorized and Nonmotorized recreation opportunities

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System.

There are seven potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills zone up through the Alpine zone Two botanical Special Interest Areas are proposed, which give special recognition to Ripley milkvetch (*Astragalus ripleyi*) and rock-loving aletes (*Neoparrya lithophila*) There are also four geologic and three historic SIAs proposed

4 Recreation and Travel Management

Recreation emphasis is on multi-season, multi-use opportunities. The developed recreation program emphasizes rehabilitating or expanding existing facilities and constructing new developed facilities where demand exists The dispersed recreation program offers a balanced mix of semi-primitive nonmotorized and motorized opportunities An increase in interpretative and educational programs is expected

A reduction in the miles of roads on the Forest is expected

5 Oil and Gas Leasing

Wilderness and recommended Wilderness areas are legally unavailable for leasing On the remaining lands, areas having high recreation values would generally be closed to leasing by management direction All other lands are administratively available and authorized for lease with standard lease terms and resource protection Stipulations On private surface/Federal minerals lands, the BLM would not lease lands with high recreation values, but could lease lands other lands About 23 wells could occur over the next ten years

Alternative F

Background: The ideas in this Alternative were initially proposed by a group of local residents working with the Colorado Environmental Coalition The Forest's interdisciplinary team (IDT) developed these ideas into a detailed alternative The Alternative is framed around the concept of island biogeography, which the citizen group feels is the best way to perpetuate biological diversity The group feels that the Alternative (as they described it) is not significantly different from the way the Forest is managed now In this Alternative, program emphasis differs from current management most noticeably in the recreation and timber programs For instance, it allows recreation in all areas of the Forest, but where a resource conflict affecting biodiversity occurs, the conflict would be resolved in favor of

biodiversity Timber management is included in the Alternative, but on a very small scale, and only in areas allocated to the General Forest, Dispersed Recreation, Scenic Byways, and Big Game Winter Range prescriptions

Theme: This Alternative emphasizes the protection of biological diversity using the concept of island biogeography (core reserves) and wildlife connective corridors The natural disturbance regime is expected to reestablish itself where feasible Human uses are allowed as long as they are compatible with protecting biological diversity

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a balance of anthropocentric and ecocentric perspectives of the environment The Alternative emphasizes preserving large tracts of land, besides designated Wilderness, in a series of core reserve allocations and areas recommended for Wilderness Connective corridors are included for wildlife dispersal between various reserve areas The natural disturbance regime is established throughout the Forest Maintenance of ecological processes, diversity, and productivity is primarily through natural means We anticipate that species viability will be maintained Use of a combination of coarse- and fine-filter approaches for conserving biodiversity will ensure sustainable ecosystems

2 Timber Suitability and Management

Lands suitable for timber production would be limited Lands suitable for timber production are limited Silvicultural prescriptions are dominated by uneven-aged management Road construction for timber management is limited Availability of, and accessibility to, other forest products is expected to be limited

3 Wilderness, Undeveloped Areas, and Other Special Area Considerations

Some unroaded areas are proposed for Wilderness and all other unroaded areas are allocated to the Core Reserve Management-Area Prescription

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System

There are seven potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills Zone up through the Alpine Zone Two botanical Special Interest Areas are proposed that give special recognition to Ripley milkvetch (*Astragalus ripleyi*) and rock-loving aletes (*Neoparrya lithophila*) There are also five geologic SIAs proposed

4 Recreation and Travel Management

Recreation is allowed but not emphasized in this Alternative Recreation allocations account for about 7 6% of the total Forest The developed recreation program emphasizes rehabilitating existing facilities and constructing new trailheads where demand exists The dispersed recreation program emphasizes semi-primitive nonmotorized opportunities, with motorized opportunities limited to recreation travel corridors No motorized uses are

allowed in Core Reserve areas Interpretative and educational opportunities are expected to increase

Travel Management places an emphasis on lower road densities and on reducing total road miles on the Forest About 856 miles of road would be closed to meet these objectives.

5 Oil and Gas Leasing

Wilderness and areas recommended for Wilderness are legally unavailable for leasing Areas considered important for protecting biodiversity are closed to leasing by management direction This alternative only makes lease decisions on areas having high potential for oil and gas; areas with lower potentials will not have availability or authorization decisions None of the available lands will be authorized for lease until a lease request is received Authorization depends on another level of environmental analysis Because so few areas are available for lease, only one well is expected and it would likely occur in the Chama Basin

Alternative G (Selected)

This Alternative is a combination of Alternative D and Alternative E The Alternative was developed as a logical outgrowth to the concerns expressed in the letters written during the comment period and in public meetings after the publication of the DEIS It represents a blend of land management allocations that reflect people's concerns about biological values and social needs These objectives would be accomplished with little or no additional development of the Forest

Theme: Many people feel that the best way to manage the Forest is through an even distribution of multiple resource uses that are managed within the capabilities of the Forest's Ecosystems Many people feel that there should be little or no additional development of the Forest This Alternative emphasizes a multiple-use approach that is designed to contribute to the diversification of the economy in and around the San Luis Valley.

Relationship to Revision Topics

1 Biological Diversity

This Alternative expresses a relatively moderate anthropocentric perspective of the environment Recreation is emphasized within the limits of sustaining ecosystems Ecological processes, diversity, and productivity will be maintained naturally or artificially where human valued outputs are desired A sustainable flow of products, services and ecosystem values that are socially acceptable, economically viable, and within the biological capability of the resources will be offered We anticipate that species viability will be maintained Where habitat conditions are significantly outside the Range of natural Variability, a program of ecosystem restoration will be started Using a combination of coarse- and fine-filter approaches to conserving biodiversity will ensure sustainable ecosystems

2 Timber Management and Suitability

Suitable timber lands consist of previously harvested areas and areas outside of Backcountry Silvicultural prescriptions applied to suitable lands will be a blend of even-aged, two-aged, and uneven-aged management Little road construction is anticipated Availability of, and accessibility to, other forest products is limited to those areas previously harvested

3 Wilderness, Unroaded Areas, and Other Special Area Considerations

There are no recommendations for additions to the National Wilderness Preservation System included in this Alternative Most of the Unroaded Areas (5,000 acres and larger) will remain undeveloped and managed to provide both motorized and nonmotorized recreation opportunities.

There are 14 rivers (126 miles) considered eligible for inclusion into the National Wild and Scenic River System.

There are six potential Research Natural Areas proposed for designation, which represent ecosystems from the Foothills zone up through the Alpine zone There are seven Special Interest Areas proposed which feature botanical, geological or historical interests.

4 Recreation and Travel Management

Recreation emphasis is on multi-season, multi-use opportunities The developed recreation program emphasizes rehabilitating or expanding existing facilities and constructing new developed facilities if/when there is a demand for them The dispersed recreation program offers a balanced mix of semi-primitive motorized and nonmotorized opportunities An increase in interpretive and educational programs is expected

A net reduction of miles of road on the Forest is expected

5 Oil and Gas Leasing

Wilderness and recommended Wilderness areas are legally unavailable for leasing Areas in Backcountry with high potential are available for lease with the No Surface Occupancy Stipulation All other lands are administratively available and authorized for lease with standard lease terms and resource protection Stipulations About 23 wells could occur over the next ten years

Alternative NA

Background: Alternative NA is the No-Action Alternative No Action means that the current management allocations, activities, and management direction found in the Forest Plan (as amended) would continue All alternatives, including Alternative NA, have some modifications to existing direction for clarification, updating to new technology, new definitions, and Standards and Guidelines

Theme: Many people think that National Forest Management should emphasize resource development, increased water yield, forage production, and dispersed recreation The No-Action Alternative emphasizes these concerns

Alternative NA also reflects new inventories and information. The 1985 Forest Plan predicted an annual rate of timber harvest of 33 million board feet of timber This was reduced to 25 million board feet annually because of Finesilver's decision Currently the Rio Grande National Forest is producing about 14 million board feet This is due to changes in Standards and Guidelines and new policies and regulations

Relationship to Revision Topics

1 Biological Diversity

Biological diversity became an issue after the 1985 Forest Plan was completed This Alternative does not focus on the "whole" of an ecosystem, it focuses on the "parts" of the ecosystem While those "parts" were the focus in 1985, they may be expanded now to include additional "parts" (landscape, community, and species) Expanding to the different levels may help to see the whole ecosystem picture The Forest Plan tended to take a smaller scale view instead of the larger (landscape) view of the Forest This Alternative attempts to provide direction for some components of biodiversity (composition, structure, and function), but focuses mainly on those that are economically important

Alternative NA is an expression of past management philosophy The Forest Service's management philosophy has changed to one of managing multiple uses within the context of a broad assessment of all resource, social, and economic values known as ecosystem management This Alternative does not adequately describe the type, quantity, and distribution of ecosystems needed to ensure long-term sustainability (i.e., maintaining site productivity, biological diversity, and natural processes) of the Forest We anticipate that species viability will be maintained

2. Timber Suitability and Management

The 1985 Forest Plan showed 870,426 acres of tentatively suited timberlands This Alternative reflects new inventories and information that reduced the amount of tentatively suited timberlands to 745,250 acres The Alternative also offers more use of uneven-aged silvicultural prescriptions than the 1985 Plan Other forest products, like firewood, will be available and accessible

3. Wilderness, Undeveloped Areas, and Other Special Area Considerations

This Alternative proposes no new Wilderness additions The Colorado Wilderness Act was passed in 1993, adding the Sangre de Cristo Range and Wheeler Geologic Area to the Wilderness Preservation System

There are no proposed Research Natural Areas (RNAs) or Special Interest Areas (SIAs) in this Alternative Both are considered in the other alternatives

The upper parts of the Conejos River were proposed for inclusion into the National Wild and Scenic River System in 1982 The Forest Plan has provided protection to maintain the Wild

and Scenic attributes of the river However, Congress has not yet designated the recommended sections of the Conejos River into the Wild and Scenic River System. The Forest would continue to manage the 36 8-mile section of the Conejos River to protect its recommended river values No other rivers are proposed for Wild, Scenic, or Recreation River eligibility under this Alternative

4 *Recreation and Travel Management*

Under the 1985 Plan, only about 6% (102,000 acres) of the Forest is allocated to recreation, while the remainder of the Forest is allocated to prescriptions that emphasize commodity uses Because the Forest Plan did not adequately address the recreation resource, a Forest Recreation Strategy was developed to better define the Forest's recreation program, areas of emphasis, and potential opportunities In addition, Wilderness Implementation Schedules were developed for each Wilderness area that outline priority projects and costs Use of these strategies will continue under this Alternative

Management emphasis for the Forest road and trail system would not change.

5 Oil and Gas Leasing

The oil and gas leasing option (alternative) is consistent with existing management allocations in the 1985 Forest Plan However, the proposed new Standards and Guidelines would replace those in the 1985 Forest Plan, including a new set of Stipulations All lands outside Wilderness are considered available and authorized for leasing with Stipulations Development of about 23 wells could occur over the next ten years

The BLM will make available and authorize leasing on private surface/Federal minerals lands, using the proposed new Stipulations

CONFORMANCE WITH THE RESOURCE PLANNING ACT (RPA)

The NFMA regulations at 36 CFR 219 12(f)(6) require at least one alternative to be developed that responds to and incorporates the *Resource Planning Act* (RPA) Program's tentative resource objectives for each Forest displayed in the Regional Guide However, the 1990 RPA program establishes national guidance for the National Forests and the National Grasslands through 1995 by providing program emphasis and trends rather than specific, quantified output targets for individual Forest Service programs As a result, no resource objectives were quantified for each Region to display in regional guide documents, which would then be passed on to individual Forests

The RPA Program is updated every five years and its three components are

* Roles in natural resource management for Forest Service management,
* Forest Service program responses to contemporary issues, and
* long-term strategies to guide the program development and budgetary process

It emphasizes four high-priority themes (1) recreation, wildlife, and fisheries resource enhancement, (2) environmentally acceptable commodity production, (3) improved scientific knowledge about natural resources, and (4) response to global resource issues. This guidance was used in the amended *Rocky Mountain Regional Guide* to shape National Forest System, research, and state and private forestry programs This process also is considered in the revision of the 1985 Forest Plan All of the alternatives analyzed in this FEIS incorporate the four high-priority themes

CONFORMANCE WITH RESEARCH NATURAL AREA DIRECTION

In November 1993, the Rocky Mountain Region issued direction to the Forests to increase the number of Research Natural Areas (RNAs) Forests were asked to insure that RNA establishment be accomplished through Forest Plan Revisions, according to 36 CFR 219 25 The RGNF has six areas that meet the criteria for RNA designation

ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER STUDY

Two alternatives were considered and eliminated from detailed study The first, Current Management with existing Standards and Guidelines, was eliminated to conform with NEPA, NFMA, and Regional direction, and the second, Alternative C was eliminated shortly after the completion of the Analysis of the Management Situation document The rationale for elimination is explained below

Current (1985) Management Plan

The NFMA regulations at 36 CFR 219 12(f)(7) state that "at least one alternative shall reflect the current levels of goods and services provided by the unit and the most likely goods and services expected to be provided in the future in the current management direction continues Pursuant to NEPA procedures, this alternative shall be deemed the no-action alternative "

As the Forest entered into revision, it was assumed the 1985 Plan would be updated and displayed as the no-action alternative The updated 1985 Plan would reflect changes such as Congressional action to designate additional Wilderness and new inventory results It became clear that significant changes had occurred, as stated the following discussion, and as a logical outgrowth of scoping, the 1985 Plan was not considered a viable alternative and eliminated from further study

Finesilver's Decision

Finesilver's Decision (Civic Action 87-F-1714) in 1989 required the analysis of suitable timberlands and ASQ Parts of the decision directed the Forest Service to assure that economic analyses are adequately discussed, include a profitable timber-production

alternative, give reasons for the selection or rejection of that alternative, and use current price data in the analysis. The order reduced the ASQ from 33.0 MMBF to 25.0 MMBF until the analysis is completed. The analysis is being done as part of the Forest Plan Revision Specific action items resulting from the court order include

* Defendants failed to identify the technology that would be employed to prevent irreversible damage to soil resources (The soil information used to determine tentatively suitable lands should address this point)

* Defendants failed to adequately explain why timber production goals were allowed to control the results of the timber production suitability analysis (The suitability analysis is being done in a totally different way and documentation of the process should be adequate to address this issue)

Suitable Land Base

The criteria for determining suitable lands have been revised or updated since the completion of the 1985 Forest Plan For instance, completion of a Forestwide soil inventory showed there are soils on lands currently classified as suitable, which are not suitable for timber management This is because they will not regenerate vegetation in five years, are too shallow, and nutritionally deficient.

The purpose of determining the tentatively suitable timber land base is to identify the amount and location of these lands. There are five initial criteria used to decide whether a particular parcel is tentatively suitable for timber production Those lands that remain suitable after applying the five criteria are termed "Tentatively Suitable Timber Lands" (TSTL) The five criteria are

1 Is the land forested? (36 CFR 219 19 (A)(1))

2 Is irreversible resource damage likely to occur? (36 CFR 219 14 (A)(2))

3 Is there reasonable assurance of adequate restocking within five years after final harvest? (36 CFR 219.14 (A)(3))

4 Is the land withdrawn from timber production? (36 CFR 219 13 (A)(4))

5 Is the land producing commercially usable timber? (FSH 2409 13-21 3)

In complying with Finesilver's Decision, these five criteria were applied This application reduced the suitable land base from the amount shown in the 1985 Plan Table 2-1 displays the difference between Acreage Summary for Tentatively Suitable Forest lands based on the criteria listed above Table 2-2 displays the difference between the 1985 Plan and the current suitable land base.

Table 2-1. Acreage Summary for Tentatively Suitable Forest Lands

CATEGORY	1985 ACRES	1996 ACRES
NFS Areas	1,851,792	1,856,757
Nonforested Lands	634,931	689,334
Forested Lands	1,216,861	1,167,423
Wilderness Areas	137,796	227,046
Nonindustrial Species	0	62,172
Irreversible Damage	0	37,190
Reforestation Incapability	0	95,765
Tentatively Suitable Forest Lands	**870,426**	**745,252**

Table 2-2. Comparison of 1985 and 1995 Timberland Acres

	Forest Plan 1985	Alternative NA 1996
Tentatively Suited Timberlands (acres)	870,426	745,252
Suited Timberlands (acres)	464,790*	298,100**
Allowable Sale Quantity (ASQ) per year	33 0 MMBF*	20 0 MMBF**

* 1985 Plan says 33 0 MMBF, but compliance with Finesilver's decision reduces potential volume to 22 0
** These numbers are taken from Alternative NA using updated criteria explained in the following section

Harvest Volume

Volume predictions were reduced when the new criteria were applied Compliance with Finesilver's Decision required the suitability assessment and assurance of the economic efficiency of the timber program The reduction in volume between the 1985 Plan and the current situation can be attributed to three factors These are

* The tentatively suitable timberland analysis as explained above

* The design of the FORPLAN model The model used in the 1985 Plan did not consider the cost of entering separate roadless areas (primarily road construction) The current FORPLAN model takes these specific costs into account, which reduces the amount of lands suitable and scheduled for harvest

* Yield tables have been updated and incorporate current technology and resource data (according to Finesilver's Decision) These changes account for some reduction in harvest levels

A combination of all these factors shows that harvest potential would be reduced to about 20 0 MMBF per year, which is lower than the 25 0 MMBF specified in Finesilver's decision It is not possible to show the volume reductions by the categories cited above, so the reduction is shown as a result of applying the suitability criteria Modeling the 1985 Plan as amended would not meet Finesilver's Decision without the changes cited above The incorporation of the changes clearly shows that the 25.0 MMBF is not achievable, and renders the 1985 Plan infeasible for use Alternative NA was designed to make the existing 1985 Plan (dropped from detailed consideration) feasible Alternative NA includes updated Standards and Guidelines

Alternative C

The second alternative dropped from further consideration is Alternative C This Alternative was not developed in response to the Revision Topics It was developed in response to internal (Forest Service) and external (general public/politicians) concerns that the Forest Service can and should operate so that it pays for itself **The primary difference between this Alternative and the Forest Plan is that all resource management programs would be designed to pay for themselves**

The Alternative could not be legally proposed (because several proposals are not within our authority to do), considered, or implemented. Detailed development and analysis of this Alternative would cause considerable effort and expense to the Forest and is not considered reasonable.

COMPARISON OF HOW THE ALTERNATIVES ADDRESS REVISION TOPICS

Each of the alternative descriptions includes a description of how the alternatives respond to the Revision Topics This section consists of subjective comparisons between the alternatives This comparison is also done by Revision Topic Comparisons include subjective rankings based on outputs, outcomes, acres, or other numerical comparisons derived from the information contained in the FEIS, Chapter 3—Affected Environment and Environmental Consequences

Biological Diversity

Each alternative provides for sustainable ecosystems. Key components of sustainability are

1) net productive capacity of the land does not decrease,
2) native species currently present on the Forest are perpetuated, and
3) natural ecosystem processes are maintained

One could think of these key components as a filter that the alternatives must pass through to maintain sustainable ecosystems Since biological diversity is so complex, key attributes were selected to ensure a high degree of certainty that the alternatives were indeed providing sustainable ecosystems Key biodiversity attributes evaluated were fragmentation

and connectivity of the Forest, old-growth forests, Threatened, Endangered and Sensitive Species, introduced species, and soils.

Each alternative proposes to alter a relatively small amount of habitat Consequently, landscape composition, structure, and function are perpetuated on the vast amount of acreage on the Forest This is especially evident when the amount and size of proposed changes are placed in a temporal context for the anticipated life of the Forest Plan Revision (10-15 years)

A brief synopsis of the conclusions found in Chapter 3 is included to show how key biodiversity attributes are addressed by key sustainability components as follows (References to sections in the FEIS are in parentheses)

1) Net productive capacity of the land does not decrease

   * Soil productivity is maintained by keeping erosion, compaction, displacement, severely burned, and nutrient losses within tolerable limits (SOILS)

   * A larger portion of the Forest will remain in an undeveloped state (OLD GROWTH, TES-PLANT, TES)

   * A comprehensive series of Standards and Guidelines for the Forest and each Management Prescription is designed to directly or indirectly ensure that the net productivity of the land is not impaired (PLAN, CH 4)

2) Native species currently on the Forest are perpetuated.

   * There is no adverse impact to Threatened, Endangered, or Sensitive species (TES-PLANT, TES, Appendices E, F, and G)

   * The habitat on the Forest will remain well distributed (TES)

   * There are no known barriers that will prevent species from using the habitat within the Forest (FRAGMENTATION)

   * The five potential corridors that connect the Forest to its surroundings will not be altered to prevent species movement (FRAGMENTATION)

   * Large amounts of late-successional forest habitat will remain outside the Forest boundary (TES)

   * The habitat beyond the Forest boundary is well distributed (TES)

3) Natural ecosystem processes are maintained

   * Most of the Forest is allocated to Management Prescriptions that allow natural processes to continue, i.e , the Forest landscapes continue a course of natural change and disturbance regimes. (TES-PLANT, OLD GROWTH)

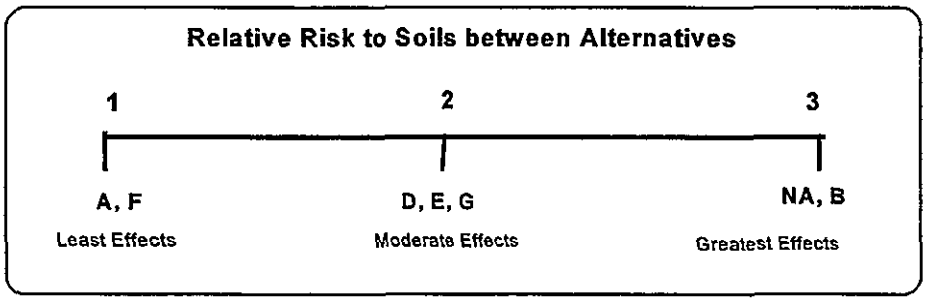
* The Forest maintains an abundance of late-successional forest habitat. (TES, OLD GROWTH)

* There is a small amount of human-caused habitat fragmentation (both existing and planned, by alternative), which should minimally disrupt ecosystem process. (FRAGMENTATION)

* Disturbance processes (specifically fire and insects and disease) will be perpetuated to the extent possible given, legal and policy limitations and the Desired Condition for an area (INSECTS AND DISEASE, FIRE)

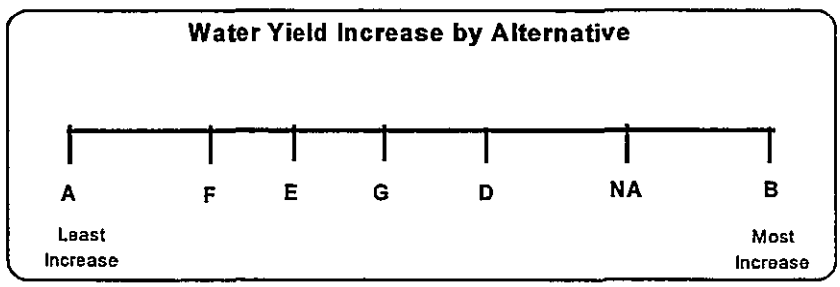
Soils

Risk to soils is due to the level of management activity in each alternative and the effect that these activities may have on soil productivity, erosion, compaction, nutrient removal, or nutrient displacement. All alternatives meet the legal and regulatory requirements for the protection of long-term soil productivity The ranking of alternatives based on risk to soils is shown below



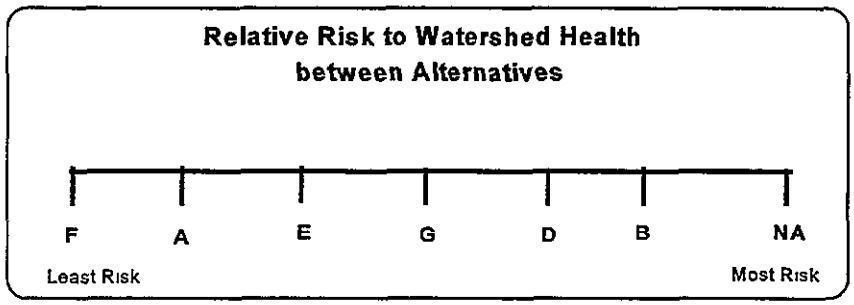
Water

Watersheds and streams can retain a healthy balance with some resource use and disturbance The RGNF intends to manage disturbances so that healthy watersheds supply needed habitat and clean water regardless of the alternative selected. This will be accomplished through a watershed by watershed analysis approach to identify the nature and extent of nonpoint sources of pollution, as required by Section 319 of the *Clean Water Act.*



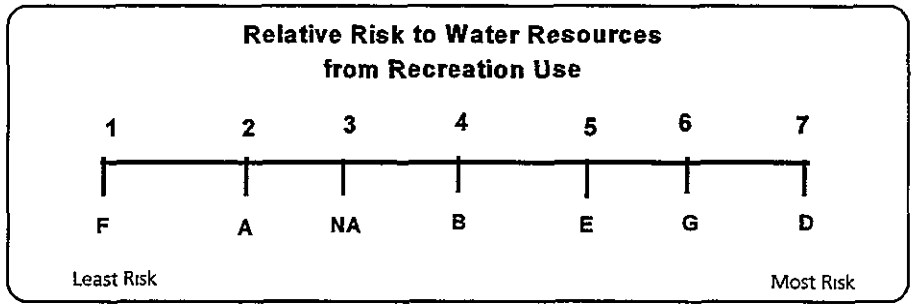
Alternatives are ranked relative to the water resource in several ways It is interesting how the alternatives compare and to some extent probably depend on an individual point of view For instance, for those interested in water yield increase, the alternatives that produce more timber harvest are more desirable For them, alternatives are ranked from least increase to most increase as shown

All watersheds on the Forest are in relatively good health, though some are at greater risk from development than others based on past management All alternatives will meet the requirements of the Clean Water Act However, for purposes of comparison, alternatives with less resource development pose less risk to watershed health So, if risk to watershed health is of primary emphasis the alternatives are ranked as shown The risk is based on associated levels of resource use



The interesting exception is recreation use A key to stream protection is the proper location of uses Many developed camp sites were located within floodplains and should be moved as opportunities become available Dispersed camping should occur a short distance from the stream as well Horses need to be pastured away from the riparian areas Off-road vehicle use can cause impacts similar to roads and must be kept out of riparian areas, except roads with designated crossings

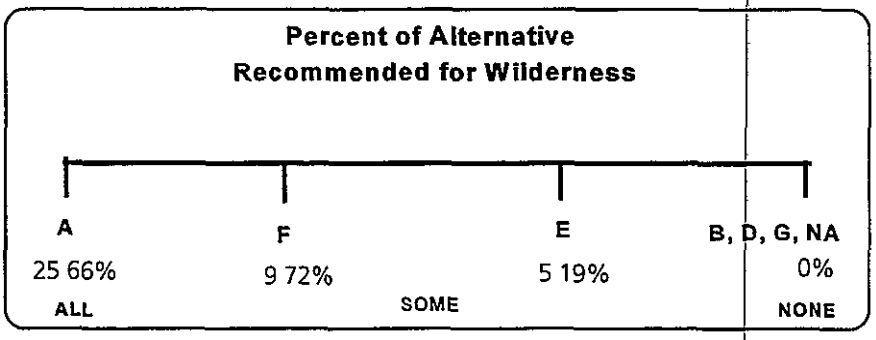
Recreation has been increasing on the RGNF, and increased use means increased impacts to water resources Impacts will be monitored and use regulated, if necessary, to prevent adverse impacts The alternatives are ranked as shown when rated relative to risk from recreation use



Wilderness, Unroaded, and Other Special Area Considerations

This Revision Topic is of primary interest on both a regional and local level The topic focuses on the disposition of the Forest's unroaded areas (5,000 acres and greater) Traditionally, the issue has centered on whether these areas should be recommended for Wilderness The issue has evolved and now centers on several different aspects These include the importance of the areas as biological preserves, undeveloped but not designated as Wilderness, sources of spiritual renewal, motorized and nonmotorized recreation, and availability for resource development The alternatives are ranked according to how much

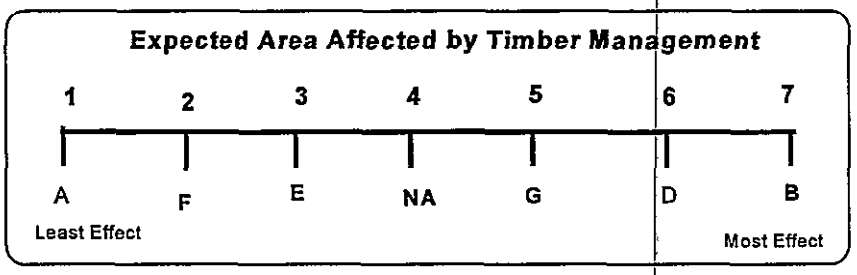
of the unroaded areas is recommended for Wilderness The reader is left to draw their own conclusions on the merits of the allocations or degree of development in each alternative.



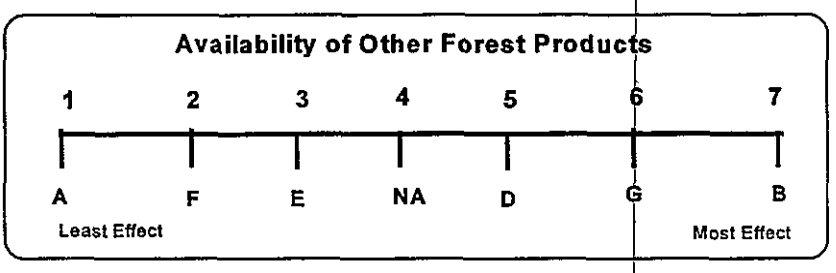
While Alternatives B and D do not recommend any areas for Wilderness, they do maintain about 20% of the alternative in Backcountry Motorized and Nonmotorized Recreation allocations Alternative NA offers little in the way of Backcountry allocations. Roughly 22% of the Forest is currently in designated Wilderness. The graphic portrays the additional lands recommended for Wilderness designation under each alternative.

Timber Management and Suitability

This Revision Topic focuses on the amount of land that is suitable and available for timber harvest and the volume of timber that can be supplied yearly on a sustainable basis. Timber resources are those resources originating from the trees of the forest The timber resource has value as a primary component within forested communities, necessary for sustaining the plants and animals that reside there, and value to the people who use wood products from the Forest's timbered lands For these reasons the alternatives are ranked according to different criteria The rankings are relative, and the reader is left to draw their own conclusions regarding the alternatives and the value derived from timber harvest or the effects of timber harvest on the timber resources of the Forest



Timber harvest would have an effect on the timber resource in terms of changes to tree stand composition, structure, and density When looking at the effect of timber management on the recreation resource, the alternatives would be ranked as shown



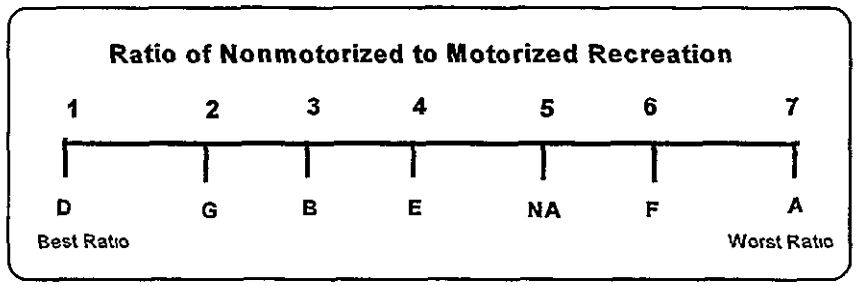
Another important aspect of the timber issue is the land considered suitable

and available for timber harvest This considers the amount of timber volume available from each alternative and the availability of forest products, like firewood, transplants, and Christmas trees This last aspect is extremely important to the San Luis Valley in terms of the availability of and access to firewood

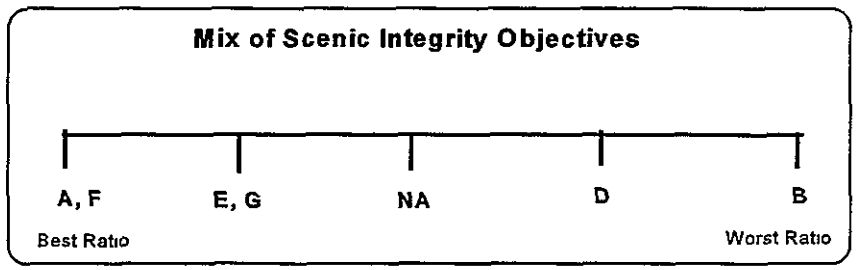
Recreation and Travel Management

This Revision Topic deals with the availability of recreation opportunities, the quality of the recreation settings (the Scenic Resource), and the access to both Public concern has focused on road closures. The alternatives treat closures the same through the range of alternatives. The Forest has identified roads that may be closed for either resource or administrative reasons, but the site-specific decision will be made by the Districts as the Forest Plan is carried out There are about 486 miles of road that may be closed in Alternatives B, D, E, and NA Alternative F has inventoried 840 miles of road for closure The additional miles are because of the core reserve area allocations, and the need to reduce road densities in areas allocated to wildlife corridors and limited use areas Alternative G has 100 miles of proposed road closures

The alternatives offer an array of recreation opportunities These opportunities range from primitive (self-reliant) to roaded natural (park-like) Each alternative offers a mix of opportunities and has been ranked from the alternative with the best opportunity mix to the worst The best is a subjective conclusion based on an alternative offering a variety of recreation opportunities The worst is another subjective conclusion based on an alternative offering only a few recreation opportunities or mostly one kind of opportunity Readers are asked to draw their own conclusions

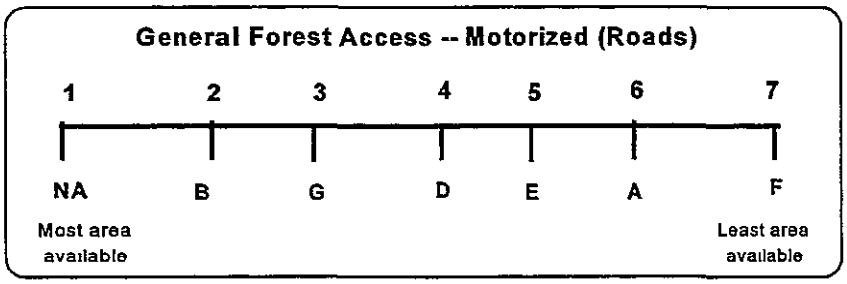


Recreation settings relate to the scenic aspect of the landscape and its condition The array of Scenic Integrity Levels in each alternative supplies the settings in which the opportunities are available The alternatives are ranked in terms of the best mix of Scenic Integrity Objectives to the worst



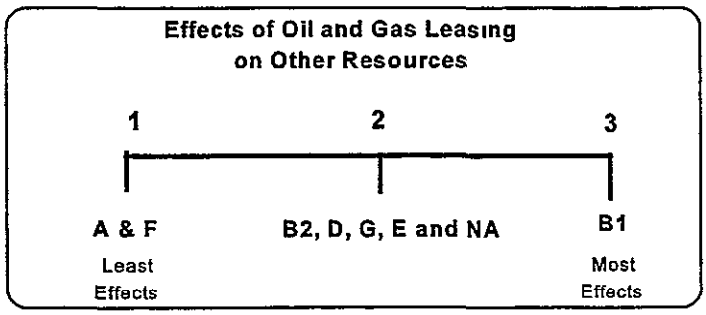
Finally, the alternatives offer access to recreation settings and opportunities The alternatives are ranked according to how much or how little motorized access is offered in each These rankings are based on the information found in Travel Management, Chapter 3,

Affected Environment and Environmental Consequences If the reader is interested in nonmotorized access then the list can be read from the bottom up Presenting the alternatives in terms of motorized access does not imply that motorized access is favored over nonmotorized access The ranking is the same for motorized trails available by alternative

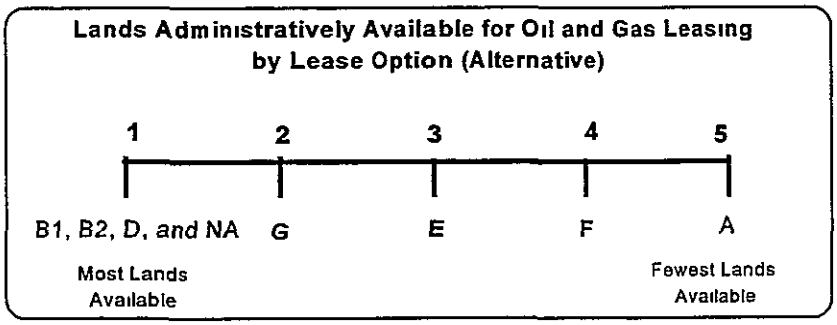


Oil and Gas Leasing

The rating system below shows the environmental consequences for the oil and gas portion of alternatives Number 1 has the least effect on resources, while higher numbers have increased effects



One decision made in the Forest Plan relates to the amount of lands administratively available for oil and gas leasing The next graphic shows the lease options (associated with alternatives) where the most lands are available for oil and gas leasing



ALTERNATIVE COMPARISONS FOR RESOURCES NOT DIRECTLY RELATED TO THE REVISION TOPICS

Economic and Financial

Each alternative produces a different mix of outputs and benefits for the area None of the alternatives generate enough revenue to cover all the financial costs Each alternative does, however, generate several monetary and nonmonetary benefits to the region

Overall, the costs of each alternative are greater than the revenues, and when examining individual programs, only the timber and oil and gas programs generate greater revenues than costs

Whether using Net Present Value (NPV or PNV), Revenue/Cost or Benefit/Cost indices, no one alternative is clearly ranked the best, given either funding level The following tables reflect the differences by indicator.

Table 2-3. Ranking of Alternatives - Present Net Value

PRESENT NET VALUE—FINANCIAL							
	1 -- BEST	2	3	4	5	6	7 -- WORST
Full Budget Level	B	G	D	NA	E	F	A
Experienced Budget Level	B	G	D	NA	E	F	A
PRESENT NET VALUE—ECONOMIC							
Full Budget Level	G	B	D	NA	E	F	A
Experienced Budget Level	B	G	D	E	NA	F	A

Table 2-4 Ranking of Alternatives - Revenue- and Benefit-Cost Relationships

REVENUE/COST							
	1 -- BEST	2	3	4	5	6	7 -- WORST
Full Budget Level	B	G	D	NA	E	F	A
Experienced Budget Level	B	G	D	NA	E	F	A
BENEFIT/COST							
Full Budget Level	G	E	D	NA	B	A	F
Experienced Budget Level	B	G	E	D	NA	F	A

Outputs from various Forest programs, as well as Forest Service expenditures, currently contribute about six percent of the Valley's employment, with a potential increase to eight percent if some of the alternatives are fully funded

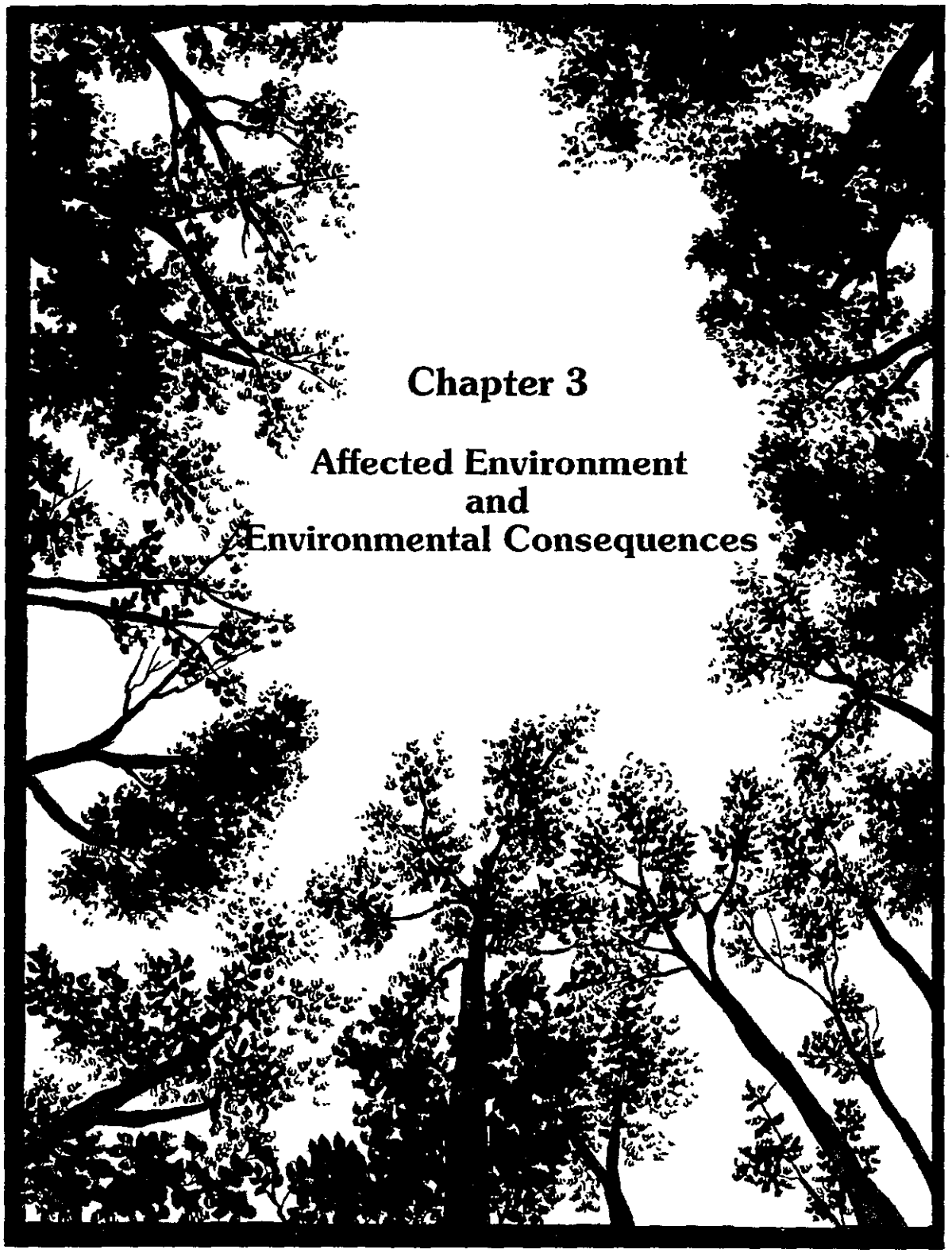
Table 2-5. Alternative Impacts to the SLV Economy

ALTERNATIVE IMPACTS TO THE SLV ECONOMY							
	1 – BEST	2	3	4	5	6	7 – LEAST
EMPLOYMENT	B	G	D	NA	E	F	A
INCOME	B	G	D	NA	E	F	A

The alternatives contribute to the Valley's county governments and school districts through the 25-Percent Fund and the Payment In Lieu of Taxes (PILT) program These contributions are very significant, particularly the 25-Percent payments to Hinsdale, Mineral, Saguache, and San Juan counties

Table 2-6. *Ranking of Alternatives - Returns to US Treasury*

RETURNS TO US TREASURY AND FUNDS TO STATES/COUNTIES						
1 – BEST	2	3	4	5	6	7 – LEAST
B	D	G	NA	E	F	A



Chapter 3

Affected Environment and Environmental Consequences

Chapter 3

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Chapter 3

Affected Environment and Environmental Consequences

PURPOSE AND ORGANIZATION OF THIS CHAPTER

This chapter combines two chapters commonly published separately in environmental impact statements. **"The Affected Environment"** and **"Environmental Consequences."** The primary purpose of this chapter is to describe the environment of the Forest and disclose the effects of the alternatives

This chapter contains a description of the physical, biological, and social elements existing on the Forest and in the surrounding area The chapter begins with a description of the Principles of Biodiversity, followed by the National Hierarchy of Ecological Units Following the Ecological Hierarchy is a section that describes Landtype Associations (LTAs) and related Cover Types found on the Rio Grande National Forest (RGNF) These two sections contain specific information used in developing the Forestwide biodiversity assessment (where information on old-growth forests, vegetative cover, Threatened, Endangered and Sensitive Species (TES) habitat, fragmentation and connectivity, etc is presented). This information is generally included in the effects of the alternatives The remaining resource discussions tier to the information presented in the Hierarchy and Biodiversity Assessment

Each write-up following the Biodiversity Assessment follow a similar format–they contain an abstract, an introduction, description of the affected environment, resource protection measures, and a discussion of effects from the proposed alternatives

This chapter contains two major sections

(1) The effects of the alternatives on specific components of the environment This section also includes a description of the affected environment This is the main body of the chapter

(2) Disclosure of resource commitments irreversible and irretrievable commitments of the resources, short-term versus long-term productivity, unavoidable adverse effects and a synopsis of energy consumption related to the implementation of the alternatives

Supporting information concerning the affected environment and environmental effects is contained in specialists' reports and records, which are on file and available for review at the Forest Supervisor's Office in Monte Vista, Colorado

COMPONENTS OF THE ENVIRONMENT DESCRIBED IN THIS CHAPTER

Not every environmental process or condition of the RGNF has been described in this document This chapter contains the description of the National Ecological Hierarchy down to the ecological units occurring on and around the Forest The interdisciplinary planning team developed a list of all the environmental and social elements likely to be affected by the alternatives, and used those as the basis for discussing the complete analysis of the environmental consequences

Following is a list of the items analyzed in this chapter The items are organized into two categories that include (1) the ecological (biological and physical) elements of the environment, and (2) the social and economic elements of the Forest

Ecological Elements

The elements that make up the Biodiversity Assessment include TES and Special-Concern Species (both plant and animal), Fragmentation and Connectivity, Old-Growth Forests, and Introduced Species Other elements include Air Resources, Timber Resources, Rangeland Resources, Disturbance Processes (Fire and Insects and Disease), Wildlife, Water and Riparian Resources, Soils, and Geology and Minerals

Social and Economic Elements

These elements affect the use and occupation of the Forest They are Research Natural Areas, Wilderness, Unroaded Areas, Wild and Scenic Rivers, Special Interest Areas, Heritage Resources, Recreation, Travel Management, and Scenic Resources

Other elements include those affecting the social and economic consequences, such as population, employment and income, payments to the counties, the social environment, Forest Service budgets, and financial and economic efficiencies

This chapter also deals with resource commitments, which include the energy requirements of the alternatives, unavoidable adverse effects, short-term versus long-term productivity, and the irreversible and irretrievable commitments of resources

ENVIRONMENTAL EFFECTS

This chapter describes the direct, indirect, and cumulative effects on the environment that would result from the activities and output levels of the alternatives described in Chapter 2 If a resource management activity has no direct or indirect effect on a particular resource under any alternative, there is no discussion regarding that management activity

Direct environmental effects are those occurring at the same time and place as the initial cause or action Indirect effects are those that occur later in time or are spatially removed from the activity Actions taken to achieve the goals of each alternative, along with past, present and foreseeable future activities undertaken by the Forest Service or other entities, would have combined or cumulative effects on the environment

The environmental consequences of alternatives are limited by management requirements to ensure long-term productivity of the land Many requirements are founded in law, federal regulations, and policies Other requirements are called Forestwide Standards and Guidelines; they apply to the Desired Conditions for each alternative The alternatives considered in detail, as a result of the Standards and Guidelines, would not produce extreme environmental consequences

RESOURCE PROTECTION THROUGH MITIGATION MEASURES

This chapter also discusses mitigation of adverse environmental effects of management activities These discussions are included in the description of the affected environment and environmental consequences for each resource section

Mitigation measures, as defined by 40 CFR 1508 20, include: avoiding the impact altogether by declining to take an action or part of an action, minimizing impacts by limiting the degree or magnitude of an action or its implementation, rectifying the impact by repairing, rehabilitating, or restoring the affected environment, reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action, and/or compensating for the impact by replacing or providing substitute resources or environments.

Key laws, regulations, and policies are identified in the Proposed Revised Forest Plan, Appendix B. Additionally, applicable standards and guidelines are found in the Plan in Chapters III and IV This Final Environmental Impact Statement (FEIS) will discuss key resource protection/mitigation measures, unconstrained effects, and effects constrained by mitigation Only key mitigation measures and/or laws, regulations, policies, or standard contract provisions will be discussed

Readers should keep in mind while reviewing these key resource protection/mitigation measures, including information contained in the Plan, that such measures should be viewed in a programmatic context Specific mitigation measures will be designed during project analyses

Finally, monitoring will determine mitigation effectiveness Refer to the Monitoring and Evaluation section of the Proposed Revised Forest Plan (Chapter 5)

THE RELATIONSHIP BETWEEN PROGRAMMATIC AND SITE-SPECIFIC EFFECTS ANALYSIS

This FEIS is a "programmatic" document, meaning that it discusses alternatives and effects for a broad program -- overall management of the RGNF. One alternative described in the FEIS, or one of similar scope, will ultimately be selected as the next Forest Plan This new Forest Plan will guide the use of resources and will establish and reaffirm rules and policies for the use of those resources

This FEIS discloses environmental consequences at the Forest level of analysis, it does not predict what will happen when Forest Plan Standards and Guidelines are carried out on each individual site-specific project. However, when the new Forest Plan is approved, the accompanying EIS will be used in "tiering " Tiering refers to the coverage of general matters

in broader environmental impact statements, with subsequent narrower analyses incorporating, by reference, the general discussions in the parent EIS and concentrating solely on the specific issues at hand (40 CFR 1502.20 and 1508.28) In other words, as site-specific projects are planned through direction given in the Forest Plan, site-specific effects analysis will be done for each project's set of environmental conditions and issues However, information of broader scope contained in this EIS will be incorporated by reference and not repeated or analyzed

In preparing this FEIS, the interdisciplinary planning team concentrated on explaining what kinds of consequences are most likely to occur across the Forest, and why they would occur Theoretically, given this FEIS and site-specific information, readers should be able to make a reasonable prediction about the kinds of environmental effects that would result from a site-specific project

ITEMS THAT WERE CHANGED BETWEEN THE DRAFT EIS AND FINAL EIS

There were several changes made between the publication of the Draft EIS (DEIS) and this Final EIS (FEIS) These changes include, but are not limited to

* The development of a new alternative - Alternative G
* Corrections of Alternative F and subsequent analysis
* The update of the RMRIS database
* The conversion of all GIS files from the MOSS/DG system to ARC
* The use of ARC acreages for all RMRIS sites
* The calculation and use of road and riparian acreages in various models
* The addition of irregular-shelterwood prescriptions
* The incorporation of the connected-disturbance analysis done for watersheds
* A complete rerun of all FORPLAN runs for all alternatives
* The addition of aspen as a noninterchangeable component of the allowable sale quantity (ASQ)
* The development of the Backcountry Prescription (3 3) for use in Alternative G
* The designation of motorized and nonmotorized trails in Alternative G

ECOLOGICAL RESOURCES

PRINCIPLES OF BIOLOGICAL DIVERSITY (a Revision Topic)

Biological diversity (biodiversity) refers to "the full variety of life in an area, including the ecosystem, plant and animal communities, species and genes, and the processes through which individual organisms interact with one another and with their environment" (USDA Forest Service, 1991) "Biodiversity at larger geographic scales, such as watersheds, landscapes, and beyond, includes the diversity of human cultures and lifestyles" (Salwasser et al , 1993) Biodiversity occurs at many different levels, which can range from the molecular scale to complete ecosystems. Therefore the term comprises the relative abundance of genes, species, and ecosystems (Office of Technology Assessment, 1987).

Biodiversity consists of three primary components composition, structure, and function "Composition" refers to naming the elements, for example, making lists of species on the RGNF "Structure" is the physical arrangement of community complexity and the landscape patchiness pattern "Function" is evolutionary and ecological processes that include nutrient cycling, disturbances, and gene flow (Noss, 1990)

Biodiversity combines the variety of the physical environment with the variety of the biological environment Both of these environments are influenced by—and in turn influence—the social and/or human environments The physical environment is climate, topography, soils, and geology The most variable of these over a human lifetime is climate Weather cycles, windstorms, and atmospheric instability can vary widely from year to year Eventually the climate tends to fluctuate within a general range, to form a predictable weather pattern in an area The biological environment is composed of the pool of available species that successfully compete for existence in an area This includes the full complement of living organisms—from inconspicuous soil bacteria and fungi to the more visible plants, fish, birds, and mammals The variety of living organisms is enormous

Biodiversity fluctuates over time and space, and scale is an important consideration. From genes and species to ecosystems and landscapes, there is an inherent ability for each level to cope with change This adaptability to change is visually evident in the vegetation patterns on the RGNF today Extensive aspen stands bear witness that natural fires have historically burned large areas of the RGNF, since aspen is the first dominant species to colonize many environments after fire In fact, overall, the RGNF is probably quite resilient to natural burning When considering other types of disturbances, it is not as clear, but the RGNF is probably capable of withstanding considerable change

The last major climate change occurred with the closing of the last Ice Age, about 10,000 years ago Since then, the climate has reached a new equilibrium within a relatively predictable range of fluctuation This degree of repetitive, predictable fluctuation is reflected in the plants and animals seen on the landscape today Only those organisms adapted to exist within the normal environmental fluctuation can successfully remain on the Forest

Another area of biodiversity change is in the pool of available animals and plants The introduction of exotic species changes biodiversity Some exotics have been intentionally

introduced while others escaped from their intended, or unintended, introductions Thus, biodiversity changes with disturbance, climate fluctuations, species migrations, and extinctions. Biodiversity has fluctuated in the past and it will continue to change in the future It does not and cannot remain static However, if exotic species are replacing native species, then this should be reason for evaluating human activities

In the past, humans have modified the environment and, in effect, modified biodiversity, for economic benefits The biodiversity present prior to settlement was different from that which resulted from unregulated resource exploitation prior to 1907 Likewise, the current biodiversity, which has been shaped to a large degree by societal values, is not the same as that of either of the two previous time periods Social values are changing toward valuing larger tracts of public land managed to protect biodiversity (Probst and Crow, 1991) Biodiversity should be conserved, but National Forests also must provide a variety of sustainable goods and services to satisfy social needs The regulations below, developed to carry out the National Forest Management Act, address biodiversity within the framework of multiple use

Legal Framework

36 CFR 219.27 Management Requirements (a) Resource protection All management prescriptions shall .(5) Provide for and maintain diversity of plant and animal communities to meet overall multiple use objectives, as provided in paragraph (g) of this section,

> (g) Diversity Management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal species, so that it is at least as great as that which would be expected in a natural forest and the diversity of tree species similar to that in the planning area Reductions in diversity of plant and animal communities and tree species from that which would be expected in a natural forest, or from that similar to the existing diversity in the planning area may be prescribed only where needed to meet overall multiple use objectives Planned type conversion shall be justified by an analysis showing biological, economic, social, and environmental design consequences, and the relations of such conversions to natural change

Since biodiversity is not static, choices made for management of the RGNF are relevant Unfortunately, it is difficult to achieve complete social agreement on priorities for conserving biodiversity Biodiversity is so complex that complete agreement or understanding may not be possible Because of the complexity, there is no widespread scientific agreement on how to measure biodiversity, or how best to perpetuate it Perhaps appeals and litigation of Forest Service decisions reflect society's disagreement over the expression of biodiversity on the National Forests

Every land-use action or inaction taken on the RGNF changes elements of biodiversity Conserving biodiversity and managing for multiple use mean choices have to be made They mean goals for each action need to be carefully assessed, and it means resource needs and human needs have to be sensitively addressed

To evaluate the impact of human actions on the biodiversity of an area, a temporal and spatial context needs to be defined and described This context then becomes the baseline from which to evaluate alternatives and their impact on the Forest's biodiversity

The temporal context is provided in a qualitative assessment of the Forest's Range of Natural Variability for its major ecosystems (Appendix A) This assessment describes the Forest's environment, the forces responsible for shaping the Forest's diversity, the influences on the biological elements, and how these have been altered by people up to the present The assessment attempts to describe the Forest's environment from the point in time when plants and animals assumed their modern evolutionary place on the landscape up through the present time, roughly from 10,000 years ago to today

The spatial context is described below, using the National Hierarchical Framework of Ecological Units (ECOMAP, 1993) as a uniform method of describing and delineating similar ecological potentials Since biodiversity does not follow political boundaries, it is essential to evaluate the Forest's biodiversity at a variety of spatial ecological scales.

Hierarchy of Ecological Units

Central to biodiversity and ecosystem management is the study of landscape spatial and temporal patterns The hierarchial structure of ecological systems allows characterization of ecosystems and the identification of patterns and processes of interest at different scales Ecosystem composition, structure, and function determine diversity patterns across a range of spatio-temporal scales The ecological hierarchy of interest is determined by the purpose of the project To determine sustainability of an ecosystem, patterns of natural or historically sustained variability must be defined at all relevant scales (Bourgeron and Jensen, 1993)

Complex landscape patterns, along with the many processes that form them, exist within a hierarchical framework This framework consists of multi-scaled systems that can be viewed as constraints in which a higher level of organization provides, to some extent, the environment that the lower levels evolve from Every level is a discrete functional entity and is also part of the larger whole Using the hierarchy concept allows us to define the components of an ecosystem or set of ecosystems, and the linkages between different scales of ecological organization

The levels of hierarchical scale used to define the management situation for the RGNF are identified below The scales of ecosystems are described in terms of vegetation patterns, biotic processes, environmental constraints, and disturbances Table 3-1 presents the National Hierarchy of Ecological Units (ECOMAP, 1993)

Table 3-1. National Hierarchy of Ecological Units

Planning and Analysis Scale	Ecological Units	Purpose, Objectives, and General Use	General Size Range
Ecoregions Global Continental Regional	Domain Division Province	Broad applicability for modeling and sampling RPA assessment International planning	1,000,000's to 10,000's of square miles
Subregions	Sections Subsections	RPA planning multi-forest, Statewide, and multi-agency analysis and assessment	1,000's to 10's of square miles
Landscape	Landtype Association	Forest or area-wide planning, and watershed analysis	1,000's to 100's of acres
Land Unit	Landtype Landtype Phase	Project and management area planning and analysis	100's to less than 10 acres

Table 3-2 summarizes the criteria used to differentiate each ecological unit in the national hierarchy (ECOMAP, 1993)

Table 3-2. Principal Map Unit Design Criteria of Ecological Units

Ecological Unit	Principal Map Unit Design Criteria [1]
Domain	• Broad climatic zones or groups (e g , dry, humid, tropical)
Division	• Regional climatic types (Koppen 1931, Trewartha 1968) • Vegetational affinities (e g , prairie or forest) • Soil order
Province	• Dominant potential natural vegetation (Kuchler 1964) • Highland or mountains with complex vertical climate-vegetation-soil zonation
Section	• Geomorphic province, geologic age, stratigraphy, lithology • Regional climatic data • Phases of soil orders, suborders, or great groups • Potential natural vegetation • Potential natural communities (PNC)[2]
Subsection	• Geomorphic process, surficial geology, lithology • Phases of soil orders, suborders, or great groups • Subregional climatic data • PNC–formation or series
Landtype Association	• Geomorphic process, geologic formation, surficial geology, and elevation • Phases of soil subgroups, families, or series • Local climate • PNC–series, subseries, plant associations
Landtype	• Landform and topography (elevation, aspect, slope gradient, and position) • Rock type, geomorphic process • Phases of soil subgroups, families, or series • PNC–plant associations
Landtype Phase	• Phases of soil families or series • Landform and slope position • PNC–plant associations or phases

Figures 3-1, 3-2, and 3-3 show Ecological Domains, Divisions, and Provinces, respectively, for the United States These Ecological Units define a very broad ecological spatial context for the RGNF Information pertaining to the Domain and Division spatial scales of the National Hierarchy of Ecological Units is described in very general terms The document provides increasing detail in discussing Province, Section, and Landtype Associations relative to the RGNF

DOMAINS

Domains are subcontinental areas of broad climate similarity The RGNF is within the Dry Domain Figure 3-1 shows the spatial relationship of the RGNF and the Dry Domain This Domain is characterized by a relatively dry climate in which annual losses of water through evaporation at the earth's surface exceed annual water gains from precipitation (Bailey, 1980)

[1] The criteria listed are broad categories of environmental and landscape components The actual classes of components chosen for designing map units depend on the objectives for the map

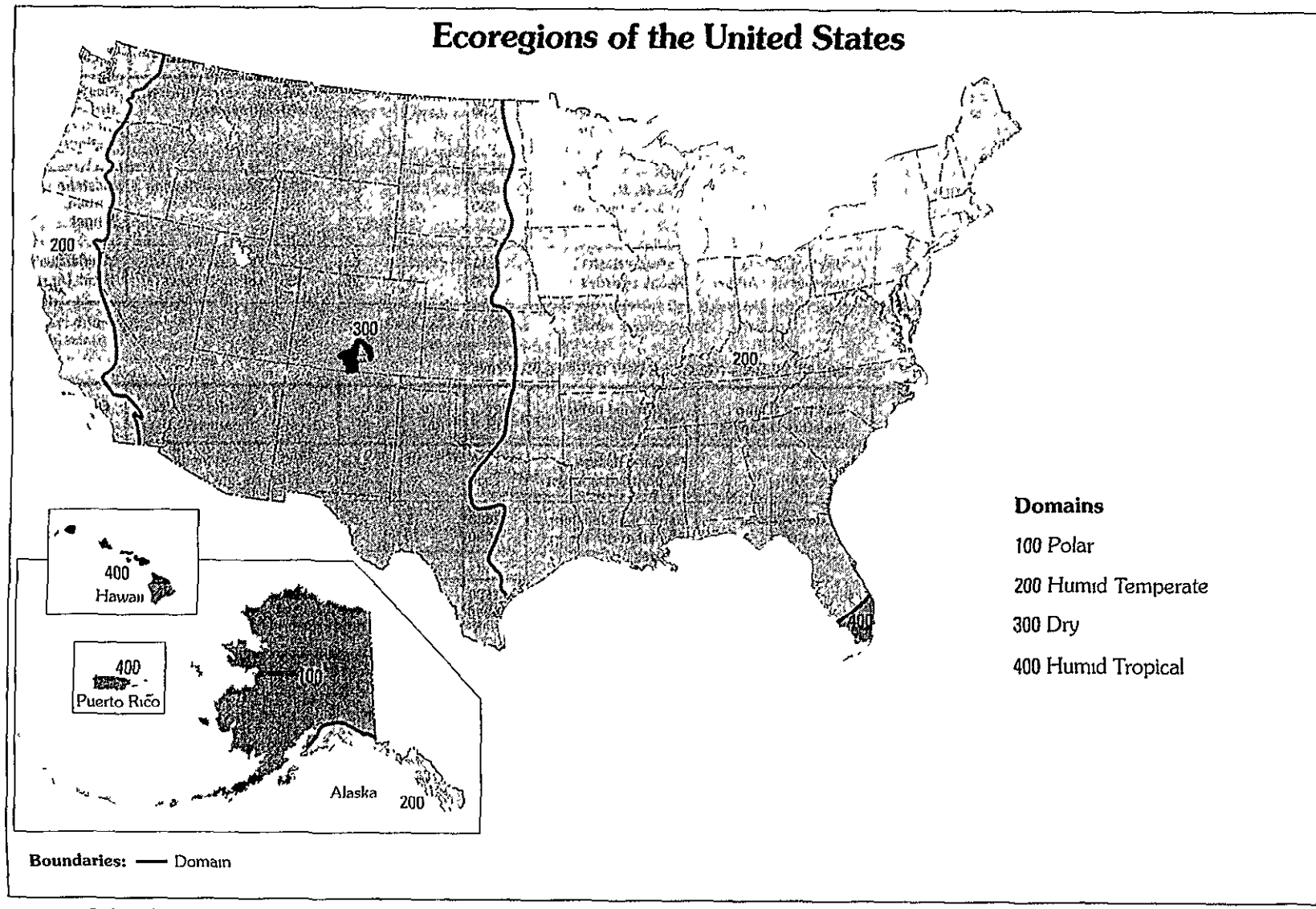
[2] Potential Natural Community–Vegetation that would develop if all successional sequences were completed under present site conditions

DIVISIONS

Domains are further partitioned into Divisions Divisions are determined by isolating areas of differing vegetation, broad soil categories, and regional climates The RGNF resides within the Temperate Steppe Division (Figure 3-2) The Division is characterized by a semi-arid continental climatic regime (Bailey, 1980)

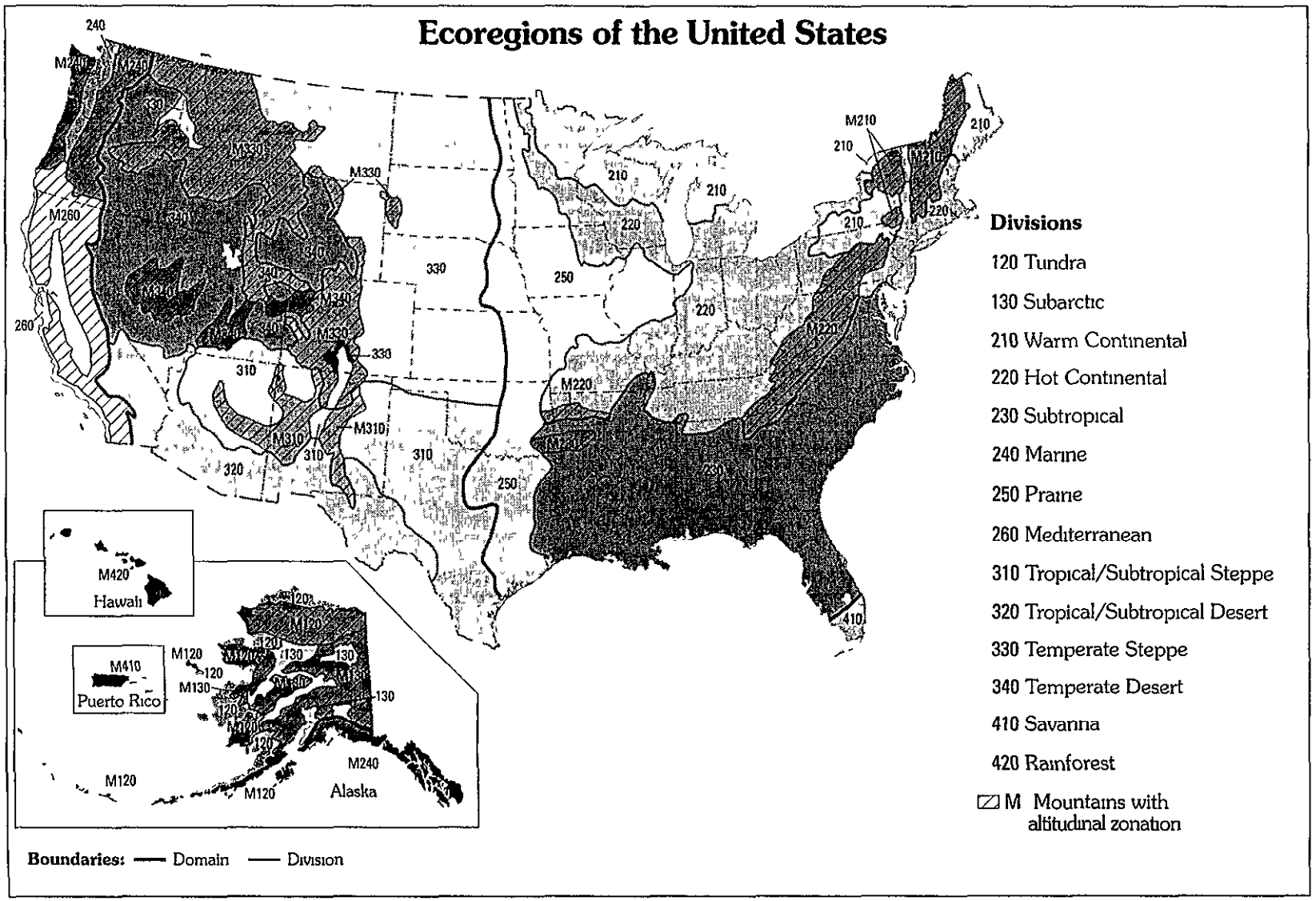
PROVINCES

Divisions are further subdivided into Provinces Provinces are determined by broad vegetation regions that are primarily controlled by length and timing of dry seasons and the duration of cold temperatures. Provinces are also characterized by similar soil orders and by similar potential natural communities as mapped by Kuchler (1964) The RGNF is within the Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow Province (M331) The Forest borders a very small portion of the Great Plains-Palouse Dry Steppe Province (331) Figure 3-3 shows the spatial relationship of the RGNF and the two Provinces mentioned above Figure 3-4 shows this in greater detail for Province M331. Following these figures are the map unit descriptions for Provinces M331 and 331 (Bailey, 1994)



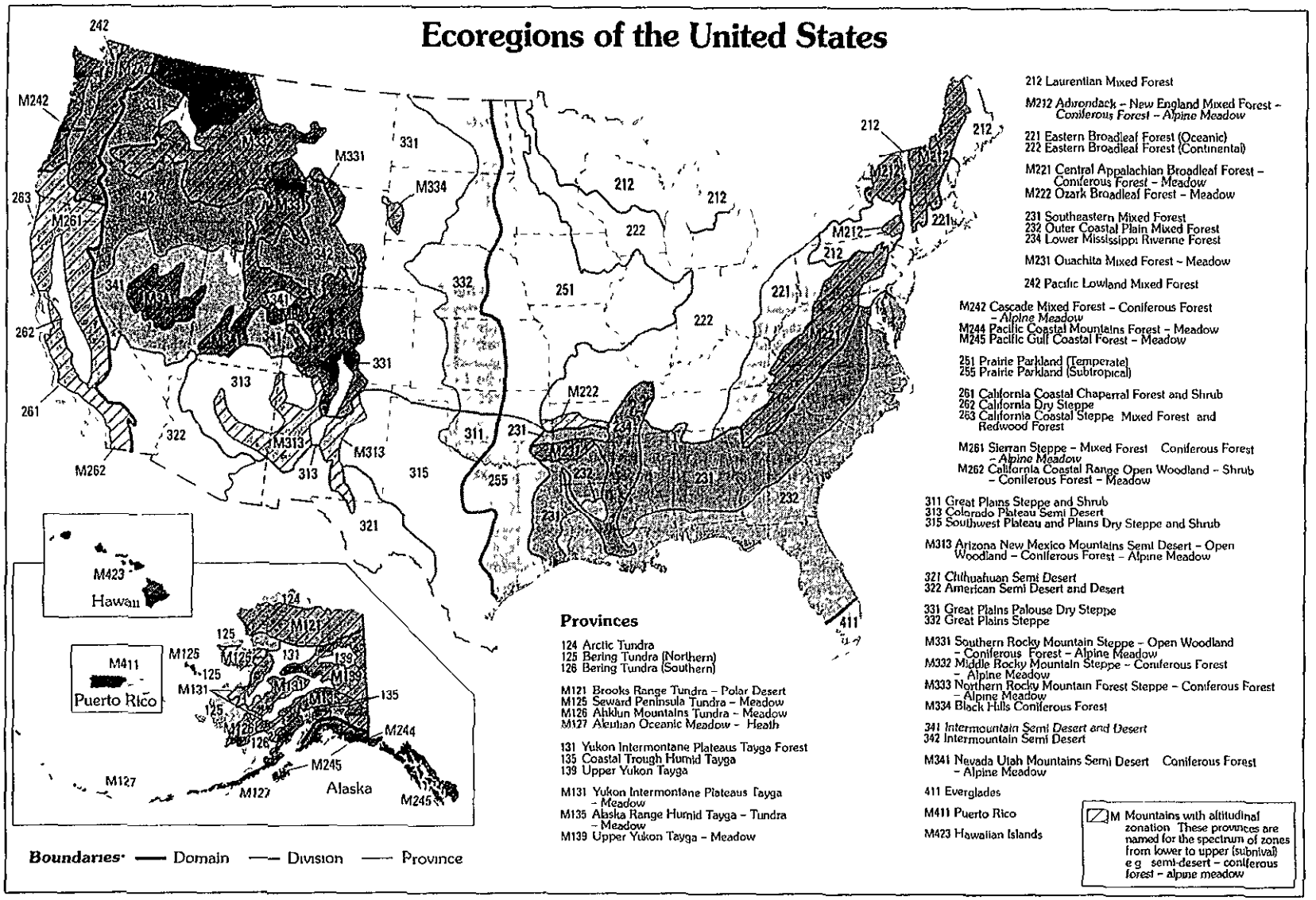
Source R G Bailey [Ecoregions of the United States, USDA Forest Service (scale 1 7,500,000, revised 1994)]

Figure 3-1. Ecological Domains of the United States



Source R G Bailey [Ecoregions of the United States, USDA Forest Service (scale 1 7,500,000, revised 1994)]

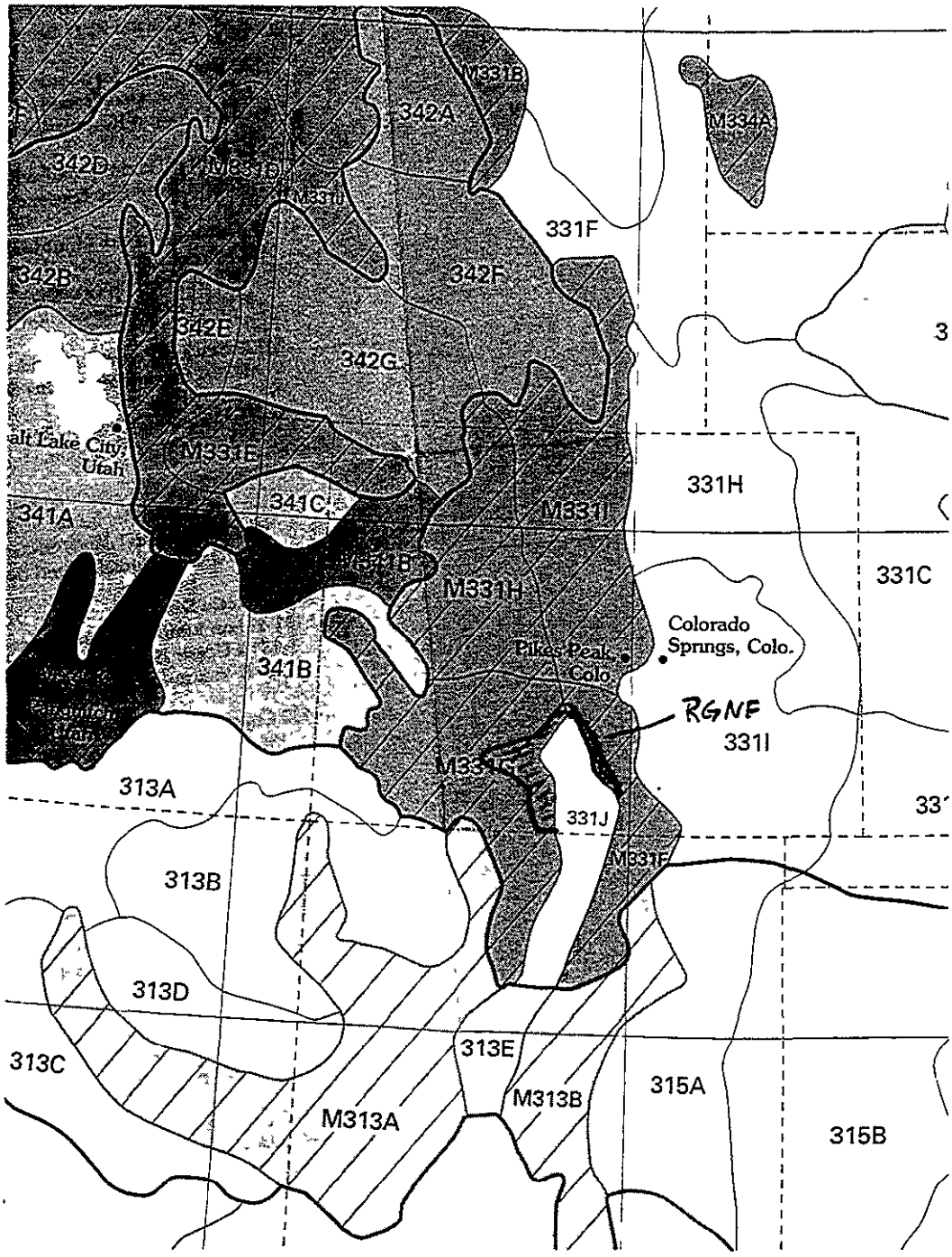
Figure 3-2. Ecological Divisions of the United States



Source R G Bailey (Ecoregions of the United States, USDA Forest Service (scale 1 7,500,000, revised 1994))

Figure 3-3. Ecological Provinces of the United States

Figure 3-4. The Dominant Ecological Province Influencing the Rio Grande NF



M331 Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow Province - Middle and Southern Rocky Mountains–102,300 sq mi (265,000 sq km)

Land-surface form --The Rocky Mountains are rugged glaciated mountains as high as 14,000 ft (4,300 m) Local relief is between 3,000 ft (900 m) and 7,000 ft (2,100 m) Several sections have intermontane depressions of "parks" that have floors less than 6,000 ft (1,800 m) in altitude Many high-elevation plateaus composed of dissected, horizontally layered rocks are in Wyoming and Utah

Climate--The climate is a temperate, semiarid steppe regime in which, despite considerable variation with altitude, precipitation falls in winter See climate diagram for Pikes Peak, Colorado Total precipitation is moderate, but is greater than on the plains to the west and the east In the highest mountains, a considerable part of the annual precipitation is snow, however, permanent snowfields and glaciers cover only relatively small areas Bases of these mountains receive only 10 to 20 in (260 to 510 mm) of rainfall Upward, precipitation increases to 40 in (1,020 mm) and temperatures decrease

Climate is influenced by the prevailing west winds and the general north-south orientation of the mountain ranges. East slopes are much drier than west slopes Within this region, the individual mountain ranges have similar east-west slope differences Average annual temperatures are mainly 35 to 45 degrees Fahrenheit (2 to 7 degrees Celsius) but reach 50 degrees Fahrenheit (10 degrees Celsius) in lower valleys

Vegetation—Well-marked vegetational zones are a striking feature Their distribution is controlled mostly by a combination of altitude, latitude, direction of prevailing winds, and slope exposure. Generally, the various zones are at higher altitudes in the southern part of the province than in the northern They also extend downslope on east-facing and north-facing slopes and in narrow ravines and valleys subject to cold air drainage The uppermost zone, the alpine, is characterized by alpine tundra and the absence of trees Next below is the subalpine zone, dominated in most places by Engelmann spruce and subalpine fir. The montane zone, immediately below the subalpine, is characterized by the dominance of ponderosa pine and Douglas-fir Frequently there is alternation in the occurrence of these two trees, ponderosa pine is dominant on the lower, drier, more exposed slopes, and Douglas-fir on the higher, moister, and more sheltered ones

After fire in the subalpine zone and in the upper part of the montane zone, the original forest trees are usually replaced by aspen or lodgepole pine

Grass, often mixed with sagebrush, regularly covers the ground under open ponderosa pine forests and some treeless areas These treeless openings usually are small, and they often alternate, according to slope exposure, with ponderosa pine forest At the lower edge of the montane zone, they may be continuous with the adjacent grass and sagebrush belt

Below the montane belt is the foothill (woodland) zone Dry rocky slopes in this zone often have a growth of shrubs in which mountain mahogany and several kinds of scrub oak are conspicuous Along the border of the Colorado Plateau Province, the ponderosa pine and pinyon-juniper associations frequently alternate extensively according to exposure of the slopes

Unforested parks are a conspicuous feature of this province Many are dominated by grasses, but some are covered largely by sagebrush and other shrubs such as antelope bitterbrush

Soils--In the Rocky Mountains, soil orders occur in zones corresponding to the vegetation zones. These range from Mollisols and Alfisols in the montane zone to Aridisols in the foothill zone In addition, because of steep slopes and recent glaciation, there are areas of Inceptisols

Fauna–Common large mammals include elk, deer, bighorn sheep, mountain lion, bobcat, beaver, porcupine, and black bear Grizzly bear and moose are in the northern portions Small mammals include mice, squirrels, martens, chipmunks, mountain cottontails, and bushytail woodrats Hawks and owls inhabit most of the region The numerous, more common birds are the mountain bluebird, chestnut-backed chickadee, red-breasted nuthatch, ruby-crowned kinglet, pygmy nuthatch, gray jay, Stellar's jay, and Clark's nutcracker. Rosy finches are found in the high snowfields Blue and ruffed grouse are the most common upland game birds

331 **Great Plains-Palouse Dry Steppe Province** - Rocky Mountain Piedmont, Upper Missouri Basin Broken Lands Palouse grassland of Washington and Idaho 290,700 sq mi (752,900 sq km)

Land-surface form --This region is characterized by rolling plains and tablelands of moderate relief They are in a broad belt that slopes gradually eastward down from an altitude of 5,500 ft (1,520 m) near the foot of the Rocky Mountains to 2,500 ft (760 m) in the Central States The plains are notably flat, but there are occasional valleys, canyons, and buttes In the northern section, badlands and isolated mountains break the continuity of the plains. The Palouse region occupies a series of loess-covered basalt tablelands that have moderate to high relief They range in altitude from 1,200-6,000 ft (370-1,800 m).

Climate--This region lies in the rainshadow east of the Cascade Range and the Rocky Mountains The climate is a semiarid continental regime in which maximum rainfall comes in summer, but the total supply of moisture is low Evaporation usually exceeds precipitation. The average annual temperature is 45 degrees Fahrenheit (7 degrees Celsius) throughout most of the region but can reach 60 degrees Fahrenheit (16 degrees Celsius) in the south. Winters are cold and dry, the summers warm to hot The frost-free season ranges from fewer than 100 days in the north to more than 200 days in Oklahoma Precipitation ranges from 10 inches (260 mm) in the north to more than 25 inches (640 mm.) in the south When precipitation does occur, it is often in the form of hail or blizzards, and tornadoes and dust storms are also frequent The climate of the Palouse Prairie region is for the most part similar to that of the central grasslands The major difference is in the timing of precipitation, with a winter maximum

Vegetation—Steppe, sometimes called shortgrass prairie, is a formation class of short grasses usually bunched and sparsely distributed, and is characteristic of this province This is a dry steppe with 6-7 arid months in each year Scattered trees and shrubs such as sagebrush and rabbitbrush occasionally appear in the steppe, and exist at all gradations of cover into semi-desert and woodland formations Since ground cover is scarce, much soil is exposed Many species of grasses and herbs grow in this province, a typical grass is buffalo

grass; sunflower and locoweed are typical plants Other grasses include grama, wheatgrass, and needlegrass Many wildflower species bloom in spring and summer The blazingstar and white prickly poppy are usually abundant The alien Russian thistle, also known as tumbleweed, is sometimes abundant. Except for the presence of shrubs, the Palouse Prairie resembles the central grasslands The dominant species, however, are distinctive They include bluebunch wheatgrass, fescue, and bluegrass.

Soil --In this climatic regime, the dominant pedogenic process is calcification, salinization is dominant in poorly drained sites Soils contain a large excess of precipitated calcium carbonate and are rich in bases Mollisols are typical Humus content is small because vegetation is sparse

Fauna--Large herds of buffalo migrated with the seasons across the steppe plains Now the pronghorn antelope is probably the most abundant large mammal, but mule deer and whitetail deer are often abundant where brush cover is available along stream courses The whitetail jackrabbit occupies the northern part of the province and the blacktail jackrabbit, the area south of Nebraska The desert cottontail is widespread. The lagomorphs, the prairie dogs, and several other small rodents are preyed upon by the coyote and several other mammalian and avian predators, one of these, the blackfooted ferret, is classed as an Endangered species The thirteen-lined ground squirrel is common here and both prairie dogs and ground squirrels are preyed upon by badgers. The Washington and Columbia ground squirrels inhabit large areas of the Palouse Prairie

The lesser prairie chicken, formerly abundant, is now classed as Threatened Sage grouse, greater prairie chickens, and sharp-tailed grouse are present in the area Among the many smaller birds are the horned lark, lark bunting, and western meadowlark Two bird species are unique to the shortgrass prairies east of the Rockies the mountain plover and McCown's longspur Mountain plovers, which resemble killdeer, live in small flocks and are often seen feeding in freshly plowed fields Construction of stock ponds has created an important "duck factory" in the northern Great Plains

SECTIONS

Provinces are further subdivided into Sections Sections are broad areas of similar geologic origin, geomorphic process, stratigraphy, drainage networks, topography, and regional climate Sections are typically inferred by relating geologic maps to potential natural vegetation "series" groupings as mapped by Kuchler (1964) The RGNF resides within two Sections and abuts a third as follows 1) M331F (Southern Parks and Rocky Mountain Ranges), 2) M331G (South-central Highlands), and 3) 331J (Northern Rio Grande Basin) Figure 3-5 shows the spatial relationship of the RGNF and these three Sections Following figure 3-5 are the map unit descriptions for the three Sections (McNab and Avers, 1994)

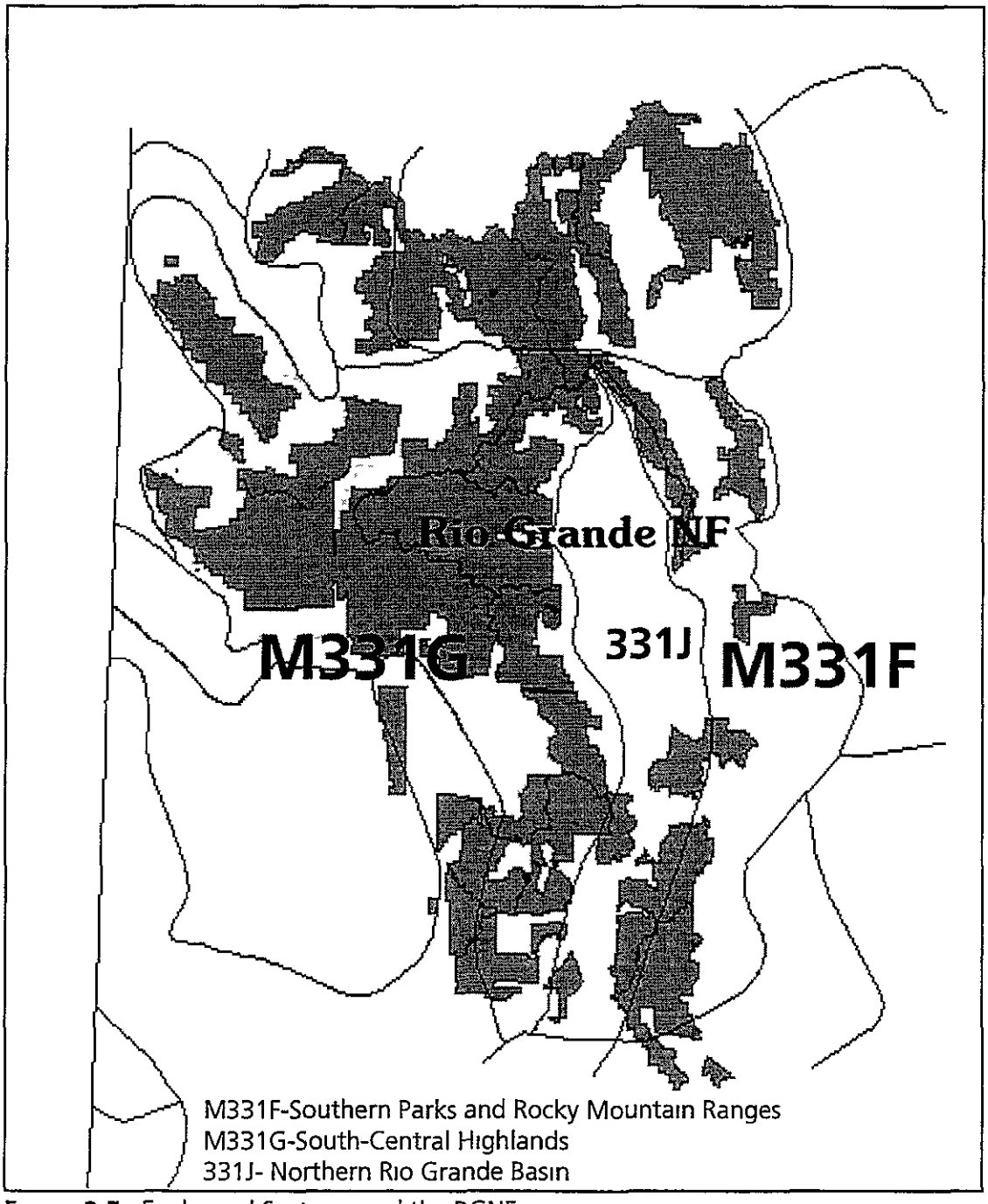


Figure 3-5. Ecological Sections and the RGNF

Ecologic sections that occur on or abut the RGNF are described below

Section M331F - Southern Parks and Rocky Mountain Ranges

Geomorphology–Included in the Southern Rocky Mountain Province, this Section is in northeast-central New Mexico and south-central Colorado Landforms are mountains and a few valley plains The Sangre de Cristo Mountains are this Section's major landform feature Elevation ranges from 7,500 to 14,000 ft (2,300 to 4,300 m)

Lithology and Stratigraphy–There are Precambrian igneous and metamorphic rocks and Cenozoic and Paleozoic sedimentary rocks A few Cretaceous through Mid-Tertiary intrusive volcanic and volcaniclastic rocks are present

Soil Taxa–Soils include Glossoboralfs with frigid soil temperature regimes and udic soil moisture regimes, and Cryoboralfs and Cryochrepts with cryic soil temperature regimes and udic soil moisture regimes

Potential Natural Vegetation–Predominant vegetation includes Douglas-fir and ponderosa pine in frigid soil temperature regimes, Engelmann spruce and subalpine fir in cryic soil temperature regimes, and kobresia, geum, and arenaria in alpine pergelic zones.

Fauna–(Incomplete at this time)

Climate–Precipitation averages 24 to 28 inches (600-700 mm) annually, with less than half of it falling during the winter Temperature averages 32 to 45 degrees Fahrenheit (0 to 7 degrees Celsius) and winters are cold The growing season lasts 70 to 110 days

Surface Water Characteristics–Water from streams and lakes is abundant and ground water is plentiful

Disturbance Regimes–Fires vary in frequency and intensity in ponderosa pine stands, but may occur when fuel load is high and dry Fire is rare in areas with cryic temperature regimes and udic soil moisture regimes The upper mountain slopes are forested, but merchantable timber is scarce Recreation, mining, and ranching are important land uses

Land Use–(Incomplete at this time)

Cultural Ecology–The Southern Parks and Rocky Mountain Ranges Section is comprised largely of high-elevation and very-high-elevation meadows and mountain ranges, principally the Sangre de Cristo Mountains. High-elevation parks and ranges present physical limitations with regard to weather patterns, reduced oxygen levels, lack of abundance and variety in plant and animal communities, and a short growing season There is little evidence of permanent occupation during prehistoric times, but high-elevation areas have been used on a relatively limited basis from the earliest dates of human occupation in the Southwest, i e , since about 12,000 years ago Although such areas are somewhat inhospitable, prehistoric peoples did make considerable use of various resources found in high-elevation areas These included lithic materials, large and small game, plant materials, spiritual-power locations, and various minerals With heavy reliance on agriculture beginning around 1000 A D , early farmers began using the lower limits of high-elevation areas to grow crops High elevation areas have the most abundant and most reliable

rainfall in the Southwest, which functioned to attract agricultural peoples, but limitations were presented by an increasingly shorter growing season with increase in elevation

In the earlier portion of the historic period in the 1600s and 1700s high-elevation activities included continued hunting and foraging by American Indians, but with the addition of Anglo fur trapping and Hispanic summer sheep pasturage As Anglo and Hispanic presence increased, such activities as hard rock mining, cattle grazing, and timber harvest and freighting grew in importance These activities were highly dependent on Eastern transportation and market systems

By the late 1800's, more and more farms, ranches, and homesteads made their appearance in the Sangre de Cristo Mountains Through construction of irrigation systems, supplied with water from the relatively abundant precipitation at high elevations, farmers and homesteaders were able to survive by growing crops to help feed cattle and sheep herds during the harsh winter months Farms, ranches, and homesteads were generally single-family operations, but a number of small towns, mostly populated by Hispanic peoples, began to spring up

Much of the area within this Section is now National Forest land, with a significant portion designated as Wilderness Economic uses of the mountains include recreation, logging, and ranching. Both Hispanic and American Indian communities continue many traditional uses of the mountains, and many of the peaks have special religious significance for nearby pueblos

The above Section description was provided by the Forest Service, Southwestern Region

Section M331G - South-Central Highlands

Geomorphology–Steeply sloping to precipitous mountains are dissected by many narrow stream valleys with steep gradients Upper mountain slopes and crests may be covered by snowfields and glaciers High plateaus and steep-walled canyons are common, especially in the west Elevation ranges from 7,545 to 14,110 feet (2,300 to 4,300 m) This Section is within Fenneman and Johnson's Southern Rocky Mountains (eastern half of the Section) and Colorado Plateaus (western half of the Section) geomorphic physical divisions.

Lithology and Stratigraphy–The San Juan Mountains area (eastern half of the Section) is Tertiary volcanic ash flows, lavas, and conglomerates with local porphyritic intrusives. The western half is mostly Pennsylvanian through Cretaceous sandstones, siltstones, shales, and conglomerates, with local carbonates near the San Juan Mountains In the extreme southern part of the Section is a small area of Tertiary sandstones, shales, and conglomerates

Soil Taxa–This area has frigid, cryic, and pergelic temperature regimes, and aridic, ustic, and udic moisture regimes Mollisols, Alfisols, Inceptisols, and Entisols are most dominant on the uplands. Great groups and suborder combinations at the higher elevations include Cryoborolls, Cryochrepts, Cryumbrepts, and Cryoboralfs Haploborolls, Argiborolls, Haplustalfs, and Eutroboralfs are dominant at lower elevations. Valley bottoms and riparian areas will have moist versions (aquic) of Mollisols and Entisols, and certain amounts of Histisols Valley bottoms often contain Fluvaquents, Cryaquents, Cryaquolls, Haplaquolls, and Borohemists

Potential Natural Vegetation–Vegetation ranges from shrub and grasslands, forests, and alpine tundra. Kuchler classified vegetation as Southwestern spruce-fir forest; *pine-Douglas-fir forest, mountain mahogany-oak scrub, Great Basin sagebrush,* juniper-pinyon woodland, and alpine meadows and barren.

Fauna–Elk, mule deer, black bear, and mountain lion are common large mammals of this Section Rocky Mountain bighorn sheep inhabit higher elevations, and moose have been recently introduced Smaller mammals include beaver, marmot, snowshoe hare, pine marten, and pica Common forest-dwelling birds are Stellar's jay, grey jay, and Clark's nutcracker, and blue grouse Mountain bluebird, broad-tailed hummingbird, and Swainson's hawk are typical summer residents Herpetofauna present include western garter snake, chorus frog, and leopard frog Native cutthroat trout have been displaced in parts of their former range by brook, rainbow, and brown trout

Climate–Precipitation ranges from 15 to 30 inches (370 to 750 mm) Temperature averages 32 to 45 degrees Fahrenheit (0 to 7 degrees Celsius) The growing season lasts less than 70 days.

Surface Water Characteristics–Water from streams and lakes is abundant Ground water is plentiful. The Rio Grande, Animas, Gunnison, and San Miguel Rivers flow through here

Disturbance Regimes–Fire, insects, and disease are principal sources of natural disturbance

Land Use–More than 50 % of this area is Federally owned, the remainder is in farms, *ranches, and private holdings Most of the grassland and much of the open woodland is* grazed Some small valleys are irrigated Recreation, mining, and timber harvest are important land uses

Cultural Ecology–(Incomplete at this time)

The above Section description was provided by the Forest Service, Rocky Mountain Region

Section 331J- Northern Rio Grande Basin

Geomorphology–This area is in the Southern Rocky Mountain Province This Section is in *north-central New Mexico and south-central Colorado Landforms include valley, lowland,* and elevated plains and hills Elevation ranges from 6,875 to 8,800 feet (2,100 to 2,680 m) The major landform features are the San Luis Valley and the Rio Grande River

Lithology and Stratigraphy–There are mostly Cenozoic sedimentary rocks and a few tertiary volcanic rocks Included also is terrestrial basin fill of later Tertiary and Quaternary age

Soil Taxa–Soils include Inceptisols, Alfisols, Entisols, Aridisols, and Mollisols Temperature regimes range from mesic to frigid Moisture regimes range from ustic to aridic

Potential Natural Vegetation–*Grama, galleta, and sand dropseed grasses and Great Basin* big sagebrush are found in ustic soil moisture regimes, and cottonwood and willow along riparian corridors Fescue-mountain muhly prairie also occurs Kuchler mapped potential vegetation as saltbush-greasewood and wheatgrass-needlegrass.

Fauna–This Section was once characterized by bison and large carnivores such as the gray wolf and grizzly bear Currently, large ungulates include Rocky Mountain elk, mule deer, bighorn sheep, antelope, and moose, cougar, black bear, and coyote comprise the large predator component throughout the Section Historical and present-day herpetofauna include Wyoming and western toads; spotted and northern leopard frogs, tiger salamander, short-horned and sagebrush lizards, the gopher snake, rubber boa, racer, and several species of garter Habitats in this Section support a rich and diverse avifauna neotropical migratory land birds, waterfowl, including trumpeter swans and common loons, raptors, including bald and golden eagles and peregrine falcons, and gallinaceous species The Colorado River cutthroat trout represents the historic salmonid component. Other fish that now inhabit the waters within this Section include the rainbow, brown, brook, golden, mackinaw, and hybrid trout, plus arctic grayling, Rocky Mountain whitefish; speckled dace; squawfish, and others Of special note is the Kendall Warm Springs dace, found only in this Section and only in one stream

Climate–Precipitation ranges from 6 to 20 inches (150 to 500 mm) annually, with less than half of the precipitation falling during the winter. Temperature averages 39 to 57 degrees Fahrenheit (4 to 14 degrees Celsius) and winters are generally cold The growing season lasts 100 to 140 days

Surface Water Characteristics–There is limited precipitation, irrigation water is provided by the Rio Grande River and small reservoirs supported by runoff from nearby mountains Wells can tap ground water in deep soils in valley plains The Chama River is an important water source in the south part of this Section The Conejos River flows through here

Disturbance Regimes–Soil salinity is a problem in much of the area

Land Use–Much of this Section is in farms and ranches About 25 % of this area is irrigated cropland Grazing and recreation are important The Great Sand Dunes National Monument is located in this Section. About 50% of the area is federally owned and about 50% is in farms and ranches About 25% of the area is irrigated Some grazing on native rangeland occurs

Cultural Ecology–Humans have inhabited and made use of the Upper Rio Grande Basin for perhaps the past 12,000 to 13,000 years For almost all of that time, people were hunters and gatherers. Virtually every one of the various ecological zones within the basin was known and used in the battle for survival. This quest mandated a non-sedentary existence and did not allow for substantial groupings of people to cluster together for more than relatively short periods of time

Sometime between 1,000 and 2,000 years ago, people began to master the techniques of being successful agriculturalists This resulted in significant lifestyle changes Only portions of the basin were suitable for habitation· those where the elevation was low enough and the latitude southerly enough to have growing seasons of sufficient length. This same agricultural lifestyle allowed for people to gather into sedentary groups and led to the rise of full-blown civilization

In the last few hundred years, Euro-Americans have come to join American Indians in the Rio Grande Basin. With them they brought new ideas of land use Once again, all of the basin's ecological zones are used. Shepherds graze their sheep in the high country and

miners extract minerals—even above timberline Contemporary cultural components include Anglo, Hispanic, and Puebloan (Taos) Tourism and recreation are major contributors to today's economy, along with ranching and mining

The above Section description provided by the Forest Service, Southwestern Region and Rocky Mountain Region

Biodiversity Assessment

This Biodiversity Assessment consists of the following evaluations

* Fine-filter assessment—an evaluation (fine resolution) of rare plants, animals and plant communities over several spatial scales The spatial scales evaluated are a series of nested geographic areas within an ecological hierarchy

* Coarse-filter assessment—an evaluation (coarse resolution) of broad habitat conditions for composition, structure, and function over several spatial scales. The spatial scales evaluated are a series of nested geographic areas within an ecological hierarchy

* Range of Natural Variability assessment—a literature review of the historical evolution and use of the Forest's ecosystems This forms a temporal perspective, the best that can be developed from historical information

Collectively, these comprise a spatial and temporal evaluation of the biological-diversity resources on or influencing the RGNF

The assessment evaluates two larger geographic levels above the Forest boundary The two geographic levels are based upon the National Hierarchy of Ecological Units (ECOMAP 1993), first, an assessment at the Ecologic Province level, and second, the Ecologic Section level (hereafter, referred to as Tri-Section) The information presented becomes more detailed as the spatial scale decreases Bailey et al (1993) say ecological units provide a consistent basis for predicting what the land could be (its potential in the future) Then, descriptions of current conditions can be used to interpret what today's possibilities are within a sustainable context.

The Province and Tri-Section evaluations should help establish a context for conditions on the Forest It should help reveal if the Forest is significant or insignificant within larger geographic scales, depending on the attribute discussed

The assessment then proceeds to describe the biological diversity resources within the Forest boundary The Forest is not an ecological unit, but a political boundary encompassing 13 Landtype Associations (the next Ecological Unit in the hierarchy below the Section) At the Forest level, the assessment addresses issues such as fragmentation and connectivity, old-growth forests, Threatened, Endangered and Sensitive species, and introduced species Finally, this leads into discussions of each resource's reaction to the proposed alternatives

Data are typically not collected and displayed by the National Hierarchy of Ecological Units Generally, it is collected and stored by political boundaries (states, counties, or ownership boundaries) Where possible, all data presented followed the Ecological Unit boundary Exceptions are noted in the text for each section

PROVINCE

Location and Area: The RGNF resides within the Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow Province (M331) (Bailey 1994) and was previously presented in Figure 3-4 A general description of the Province discussing land-surface form, climate, vegetation, soils, and fauna was previously provided earlier in this chapter The Province includes portions of: Montana, Idaho, Wyoming, Utah, Colorado, and New Mexico There are about 65,851,200 acres within the Province

Cover Types: The USDA Forest Service mapped the forested land as a part of the *Resources Planning Act* (RPA) 1993 assessment update (Powell et al., 1993) Applying this information to the Province, the broad cover types and acreages are as follows (Table 3-3)

Table 3-3. Province Cover Types and Acreages

COVER TYPE	Acres	% of total
Elm/ash/cottonwood (predominately cottonwood)	9,100	< 1%
Douglas-fir	3,702,200	6%
Ponderosa pine	5,269,300	8%
Lodgepole pine	9,781,700	15%
Spruce/fir (Engelmann spruce, subalpine fir, Colorado blue spruce)	8,776,500	13%
Oakbrush (chaparral) (predominately Gambel oak)	1,601,700	2%
Pinyon/juniper	8,115,900	12%
Western Hardwoods (predominately aspen and alder)	2,956,100	4%
Aspen/birch (predominately aspen)	2,080,200	3%
Nonforested	23,316,900	35%
Water	241,600	4%
TOTALS	65,851,200	100%

The dominant cover type of the Province is nonforested The major forested cover type is lodgepole pine. Spruce/fir and pinyon/juniper are also significant cover types Forested cover types comprise roughly 65% of the land area.

Age of Forested Cover Types: Data are not specifically available for the Province, but there is information available for the Forest Service's Rocky Mountain Region (Colorado, most of Wyoming, and small portions of South Dakota, Nebraska, and Kansas) According to the Biological Diversity Assessment done for this Region, the major forested communities are lodgepole pine, ponderosa pine, Douglas-fir, spruce/fir, aspen, and pinyon/juniper The majority of these forests are older forests in excess of 100 years (USDA Forest Service, 1992). Age classes for each dominant forested cover type are presented below The data are from the Rocky Mountain Region, but should be representative of the Province

About 70% of the lodgepole pine cover type is between 80 and 180 years old Stands of lodgepole pine at lower elevations start becoming high risk for bark beetles between the ages of 120-140 years of age The younger stands that are present are a result of past timber harvests and fires. Figure 3-6 shows the lodgepole pine cover type age-class distribution

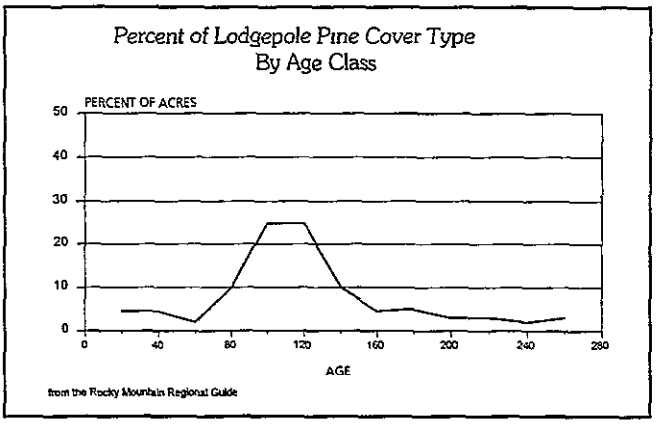


Figure 3-6 Lodgepole Pine Cover Type by Age Class

About 70% of the ponderosa pine cover type is between 60 and 140 years old Ponderosa pine can live to be 600 years old and usually does not slow down in growth until 150 to 225 About 10% is considered to be mature or older. Like lodgepole pine, the younger stands of ponderosa pine are a result of past timber harvests and fires The open stands of ponderosa pine provide an understory of vegetation that is used by livestock and wildlife Figure 3-7 shows the ponderosa pine cover type age-class distribution

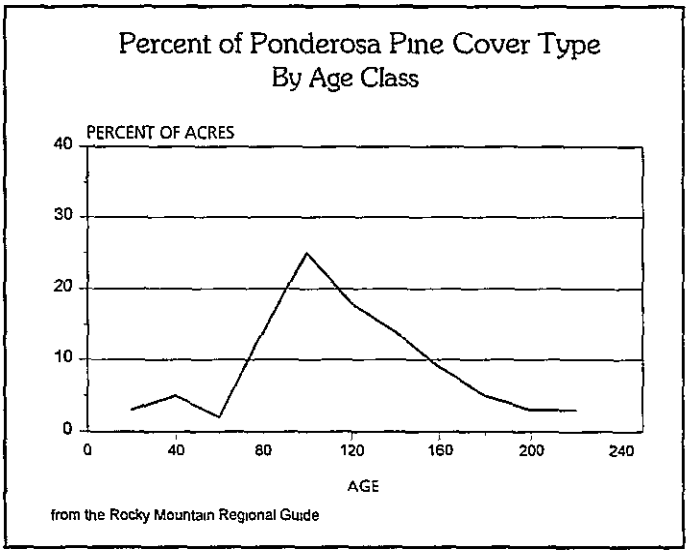


Figure 3-7. Ponderosa Pine Cover Type by Age Class

About 75% of the Douglas-fir stands are between the ages of 80 and 180 In the northern and central Rockies, this community normally stops growing at about 200 years old Only a small percent is beyond 200-220 Figure 3-8 shows the Douglas-fir cover type age-class distribution

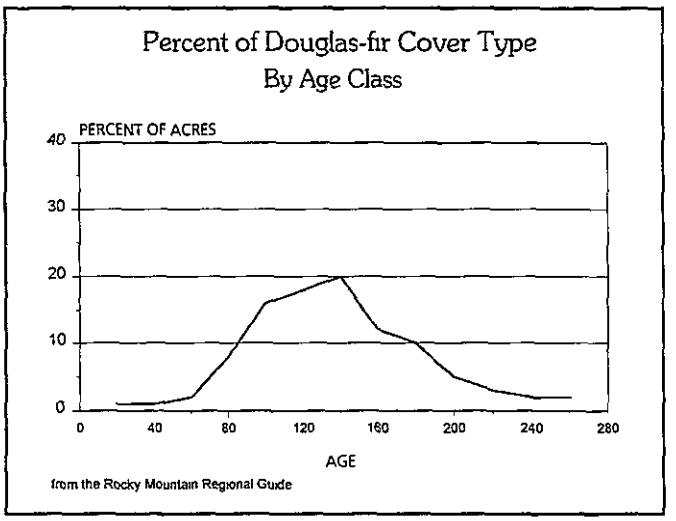


Figure 3-8. Douglas-fir Cover Type by Age Class

Aspen normally lives only 80-90 years before pathogens start causing death Seventy-eight percent of the aspen stands are between 60 and 120 years old About 44% are beyond age 80 The amount of aspen is expected to decline as disease-causing organisms, insects, diseases, and the invasion of conifer trees affect the older stands The aspen communities produce high yields of shrubs, forbs, and grasses available to livestock and wildlife Figure 3-9 shows the aspen cover type age-class distribution

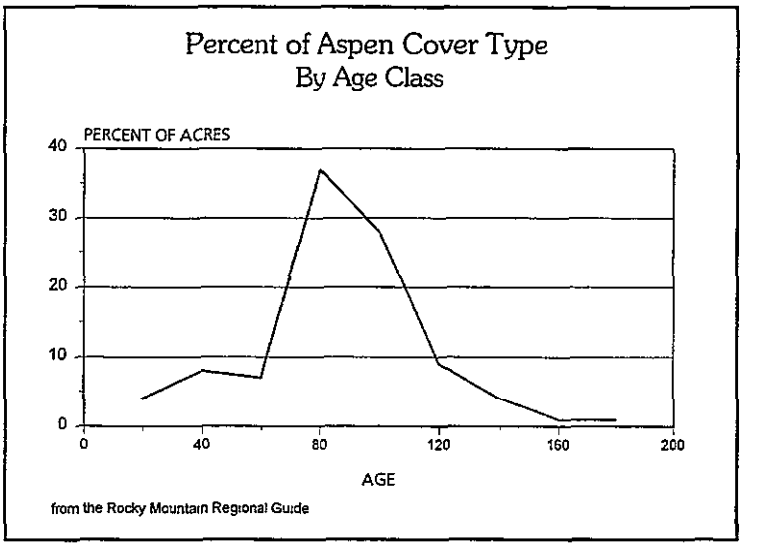


Figure 3-9. Aspen Cover Type by Age Class

Roughly 77% of the spruce/fir in the Region is between the ages of 80 and 220 Some spruce forests can reach an age of 500 years The spruce/fir community is the most diverse of the cover types in terms of different ages represented The younger forests present are primarily a result of past timber harvesting Figure 3-10 shows the spruce/fir cover type age-class distribution

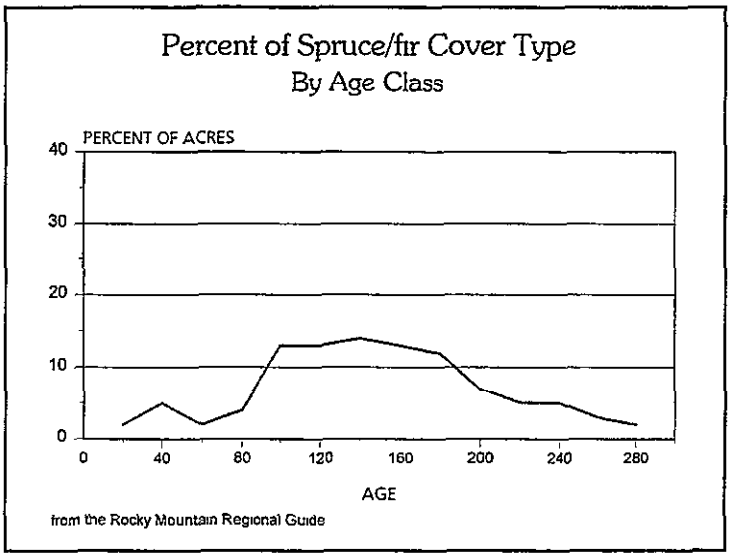


Figure 3-10. Spruce/fir Cover Type by Age Class

There is not as much information available for pinyon/juniper communities, but it is also composed primarily of older trees

Insects and Disease: According to the Biological Diversity Assessment done for this Region (USDA Forest Service, 1992), the Region as a whole is in moderate to high risk of insect epidemics because of the large amount of older trees Insect epidemics are currently occurring in two places in the Region the Uncompahgre Plateau in Colorado, and the Laramie Peak area in Wyoming Insect and disease outbreaks have occurred in the past in the Wind River Mountains in Wyoming, the Black Hills in South Dakota (outside the Province), and in Colorado along the Front Range and in the central part of the state In areas suffering from drought, outbreaks can be expected in the near future, since trees are stressed and more susceptible to attack

Timber Resource: Of the cover types listed in Table 3-4, Douglas-fir, ponderosa pine, lodgepole pine, and spruce/fir currently have the highest value for wood products

Not all of these forested lands are available for timber harvest "Timber harvest", as used here, means cutting and thinning of trees According to Forest Service Plans, Bureau of Land Management programs, state programs and activities on private land, some 6,133,600 acres are available This represents 22% of the forested lands (cover types currently valued for wood products) and 9% of the total Province acres

Table 3-4. Selected Province Cover Types

COVER TYPE	ACRES	% OF TOTAL
Douglas-fir	3,702,200	13%
Ponderosa Pine	5,269,300	19%
Lodgepole Pine	9,781,700	36%
Spruce/fir	8,776,700	32%
TOTAL	27,529,700	100%

Not all lands identified as available for timber harvest are treated in any year, or even in a decade It is estimated that 2-5% of the forested lands could be affected by some kind of timber harvest in any one decade. This means that over the long term up to about 22% of the forested lands could be altered by timber harvest The other 78% would change through natural processes of fire, insect and diseases, other natural disturbances, and growth and death

These forest cover types are habitat for many species of wildlife associated with older forests While it cannot be said that all of this habitat is suitable and occupied, there is potentially a significant amount of habitat associated with older forests The likelihood of this older-forest component being altered by timber harvest is low However, there are localized exceptions where the combination of timber harvest and fires has greatly reduced the abundance of older-forest habitats

Of the major forested cover types in the Province, ponderosa pine has probably been altered the most by human activities such as logging, residential and recreational development, and fire suppression Preliminary work on the range of natural variability for Rocky Mountain ecosystems indicates that older ponderosa pine forests were not widespread or abundant They also were more of an open forest, not the dense, multi-layered forest that people tend to describe when discussing old-growth forests in general

Livestock Grazing: Information is not available on how much of the Province supports domestic livestock grazing For the Rocky Mountain Region of the Forest Service, based on the Biological Diversity Assessment done for the *Regional Guide*, about 40% of the National Forest System land base supports livestock grazing (USDA Forest Service, 1992) However, this includes the National Grasslands, which are not within the Province proper Thus the 40% figure would actually be somewhat lower

Special Land Category: "Special lands" are Wilderness, roadless areas, Wild and Scenic Rivers, and National Park Service lands About 6,602,800 acres, or roughly 10%, of the Province is Wilderness There are 272 miles of designated Wild and Scenic Rivers More detailed special-land-category allocations were available only for the Colorado and New Mexico portions of the Province There are 9,419,343 acres in Wilderness, roadless areas, or National Parks, Monuments, or Recreation Areas

Recreation: Since this Province covers the spine of the Rocky Mountains, it is a popular recreational area for the United States Table 3-5 shows the recreation use for Forest Service lands only

The greatest recreation use is in the Utah and Colorado National Forests

More detailed recreation data, by special land category (Wilderness; roadless area, or National Park, Monument, or Recreation Area), were only available for Colorado and New Mexico's portion of the Province (Table 3-6) But this gives some relative idea where most of the use is occurring, by special-land category

National Park Service lands receive the most recreation use per unit of land (8 9 - 17 1 RVD's per acre) Roadless areas receive the next highest recreation use per unit of land (4 9 - 6 0 RVD's per acre), and Wilderness the least (5 RVD's per acre)

Table 3-5. Province Recreation Use by National Forest

STATE	FOREST	TOTAL RVD'S (1000'S) [1/]
Montana	Gallatin	2,982 2
	Beaverhead	898 7
Wyoming	Bighorn	1,803 6
	Shoshone	1,312 3
	Medicine Bow	953 1
	Bridger-Teton	2,032 0
Idaho	Caribou	965 0
	Targhee	3,517 7
Utah	Wasatch/Cache/Uinta	35,060 5
	Ashley	4,042.0
Colorado	Arapaho-Roosevelt	5,892 2
	Routt	2,373 7
	White River	9,039 0
	Grand Mesa-Uncompahgre-Gunnison	4,931 0
	Pike-San Isabel	6,928 0
	Rio Grande	**1,275 9**
	San Juan	1,707 0
New Mexico	Carson	1,715 0
	Santa Fe	2,830 1
	TOTAL	90,261 0

[1/] One RVD is equal to 12 hours of recreation for one person, or one hour of recreation for 12 persons, or any combination thereof

Table 3-6. Summary of Ownership, Special Land Category, Acres, and Recreational Use for Colorado and New Mexico's portion of the Province

OWNERSHIP	SPECIAL LAND CATEGORY	ACRES	RVD's [4/]	RVD's/Acre
Federal [1/]	Wilderness [2]	3,592,400	1,764,000	5
Forest Service	Roadless Area [2]	4,312,928	26,014,600	6 0
Bureau of Land Management	Roadless Area [3]	771,822	3,741,200	4 9
National Park Service	Park or Monument [2]	650,193	5,802,700	8 9
National Park Service	Recreation Area [2]	92,000	1,575,000	17 1
		TOTAL	9,419,343	

[1] Forest Service and Bureau of Land Management lands
[2] Data for Colorado and New Mexico portion of the Province only
[3] Data for Colorado portion of Province only
[4] One RVD is equal to 12 hours of recreation for one person, or one hour of recreation for 12 persons, or any combination thereof

Rare Species: Nationwide, the list of federally designated Threatened and Endangered species contains 960 species—434 animals and 526 plants (USDI Fish and Wildlife Service, 1996) Flather et al (1994) compiled a summary of Threatened and Endangered species for the entire United States by county Endangered species are not evenly distributed across the country There are distinct areas where there is a high number of Threatened and Endangered species, relative to the size of the land area Florida, Southern Appalachia, and the arid southwest are prominent regions that support an especially high number of Threatened and Endangered species The Province, relative to the rest of the US, is low to moderate in terms of Threatened and Endangered species occurrence

Air Quality: Air quality data have not been generated specifically for the Province This Province can be broadly characterized, however, by references that describe conditions for the Western United States (US)

Potential for severe air pollution problems is determined by weather and topography Weather that allows for accumulation of pollutants is common over large areas of the Western US The potential for problems is probably greater than for the Eastern US Most areas in the West, and in this Province, have low population densities, and pollution emissions are a fraction of what they are in the East As the Western population grows, the frequency and severity of air-pollution episodes is expected to increase (*Air Pollution and Western Forests* [1991], Binkley) For example, estimated emission increases from 1980-2030 for sulfur dioxide (SO2) and nitrogen oxides (NOx) in this Province are 42% and 142% respectively (NAPAP Interim Assessment Vol II, pp 3-28 & 3-29)

Data indicate air pollution has increased over the West since 1985 Although this is probably more from distant pollution sources, the challenge to Westerners is to guide population, industrial growth, and societal behavior to prevent pollution problems like those experienced in the East and in Europe.

Ozone is the pollutant of greatest concern in the West, mainly due to personal motor vehicles Although ozone levels are not as bad as in California, they do reach levels of concern in the Colorado Rockies during summer months Forests close to large urban and industrial complexes are more likely to receive higher air pollution exposure than forests farther from pollution sources However, large areas of the West lack data which could refute this conclusion (*Air Pollution and Western Forests* [1991], Bohm)

The Province contains portions of almost all the airsheds identified in the Region 2 air-quality assessment (*Managing Air Resources in the Rocky Mountain Region*, July 1993) Major pollution sources whose impacts are increasing include oil and gas activities (increases in nitrogen oxides-NOx, sulfur dioxide-SO2, and carbon monoxide-CO), power plants (increase in NOx, SO2, and particulate matter-PM), mineral developments (increasing dust), and ski-area emissions (increase in PM and volatile organic compounds)

Fifteen counties in Colorado and one in Wyoming are experiencing violations of national air-quality standards Counties in Colorado include Archuleta, San Miguel, Prowers*, Fremont, Pitkin, Routt, Boulder, Adams*, Arapahoe*, Denver*, Douglas, Jefferson, El Paso, Larimer, and Weld* The county in Wyoming is Sheridan The counties marked with an asterisk (*) are outside the Province

Water: Aquatic resources are best assessed by watersheds Provinces and Tri-Sections are composed of portions of many different watersheds that are not connected hydrologically Rather than consider water by Province, Tri-Section, and Forest, the evaluation will be for the entire Rio Grande drainage area (Colorado, New Mexico, Texas, and Mexico) See Figure 3-11

Rio Grande water use is governed by the Rio Grande Compact, a binding agreement between the states of Colorado, New Mexico, and Texas Through this Compact, a specified amount of water must be delivered from one state into another The Closed Basin Project helps Colorado make its delivery commitments to New Mexico Sixty-thousand acre feet of water must also be delivered to Mexico every year, according to a treaty between the United States and Mexico.

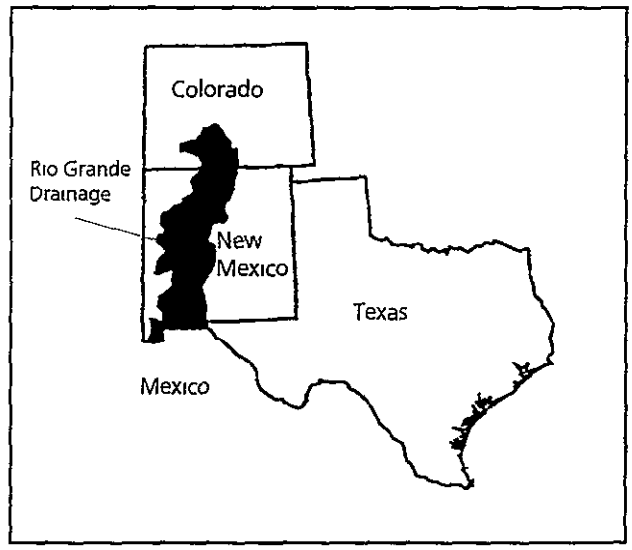


Figure 3-11. The Rio Grande drainage

Rio Grande water picks up pollution as it moves downstream The Rio Grande was recently named the continent's most Endangered river by American Rivers (a national organization that emphasizes protection of river systems and encourages Congress to designate Wild and Scenic Rivers). The reasons are many, industrial plants pour in toxic chemicals and support large communities, some with no sewage treatment. Intensively farmed fields also contribute pollution Most of the pollution to the Rio Grande occurs off the RGNF

Population: People place demands on National Forests, so it is relevant to see where population change is occurring, and at what rate Table 3-7 summarizes the growth rate, by state, for the affected counties in the Province The growth rate is the change between the 1980 and 1990 censuses

Table 3-7. Population Growth Rate by State for Province

STATE	NUMBER OF AFFECTED COUNTIES	GROWTH RATE (1980-1990)
Colorado	43	+14%
Idaho	10	+ 9%
New Mexico	8	+21%
Montana	8	+ 8%
Utah	11	+16%
Wyoming	18	- 4%
	98	+10% (for all 98 counties)

The average population change for all 98 affected counties was 10%. The average change for the entire U S. was 9 8% for this same period (Case, 1995) So Province growth was similar to national growth

The New Mexico portion of the Province saw the highest population increase (21%) Most growth appeared to be related to the counties associated with Albuquerque, Santa Fe, and Taos The lowest growth rate was

experienced by Wyoming (-4%), but some significant growth was experienced in the state's extreme western portion. Montana experienced moderate growth, with the highest increase around Bozeman Every county in eastern Idaho showed positive population growth In Utah, the counties from Ogden to Provo appear to be growing rapidly, compared to the rest of Utah's affected counties Colorado shows significant growth along the Front Range (eastern boundary of the Province) from Fort Collins to Colorado Springs There is also significant growth along the I-70 corridor from Denver to Grand Junction, and along the corridor from Farmington, New Mexico, to Montrose, Colorado

The major metropolitan areas within or immediately adjacent to the Province have, and will continue to have, an influence on the Province Table 3-8 shows the cities, by state, which exceed 50,000 people

People are concentrated in three geographic areas: along the Front Range of Colorado, along the Wasatch Front in Utah, and along the bottom periphery of the Province in New Mexico These urban areas are concentrated on the periphery of the Province The interior of the Province remains relatively unpopulated, in comparison to the urban areas shown in Table 3-8

Table 3-8. Cities over 50,000 within Province

State/City	1990 Census
Colorado	
Arvada	89,235
Aurora	222,103
Colorado Spgs	281,140
Denver/metro area	467,610
Ft Collins	87,758
Lakewood	126,481
Longmont	51,555
Pueblo	98,640
Westminster	74,625
TOTAL	1,499,147
Idaho	
None	
Montana	
Billings	81,151
New Mexico	
Albuquerque	384,736
Santa Fe	55,589
TOTAL	440,595
Utah	
Ogden	63,909
Orem	67,561
Provo	86,835
Salt Lake City	159,936
Sandy	75,058
W Valley City	86,975
TOTAL	540,274
Wyoming	
Cheyenne	50,008

The highest concentration of people is along the Front Range of Colorado and Wyoming (from Pueblo to Cheyenne) There are 1 5 million people that are roughly two to six hours from the RGNF by automobile

Recent population projections from the US Census Bureau indicate that Wyoming, Colorado, Utah, Arizona, and New Mexico will experience some of the highest rates of population growth in the entire nation through the year 2020 This growth will put high levels of pressure on the surrounding ecosystems

Figure 3-12 shows the projected growth rates through 2000 Figure 3-13 shows the projected growth rates from 2000 to 2010

Figure 3-12.

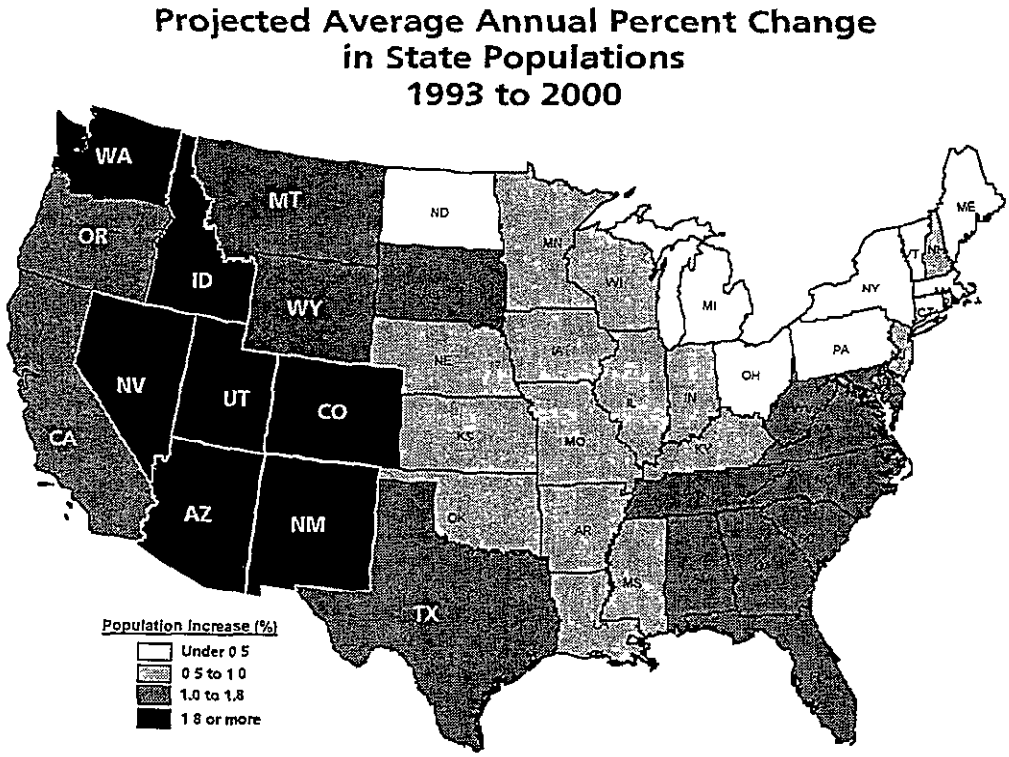
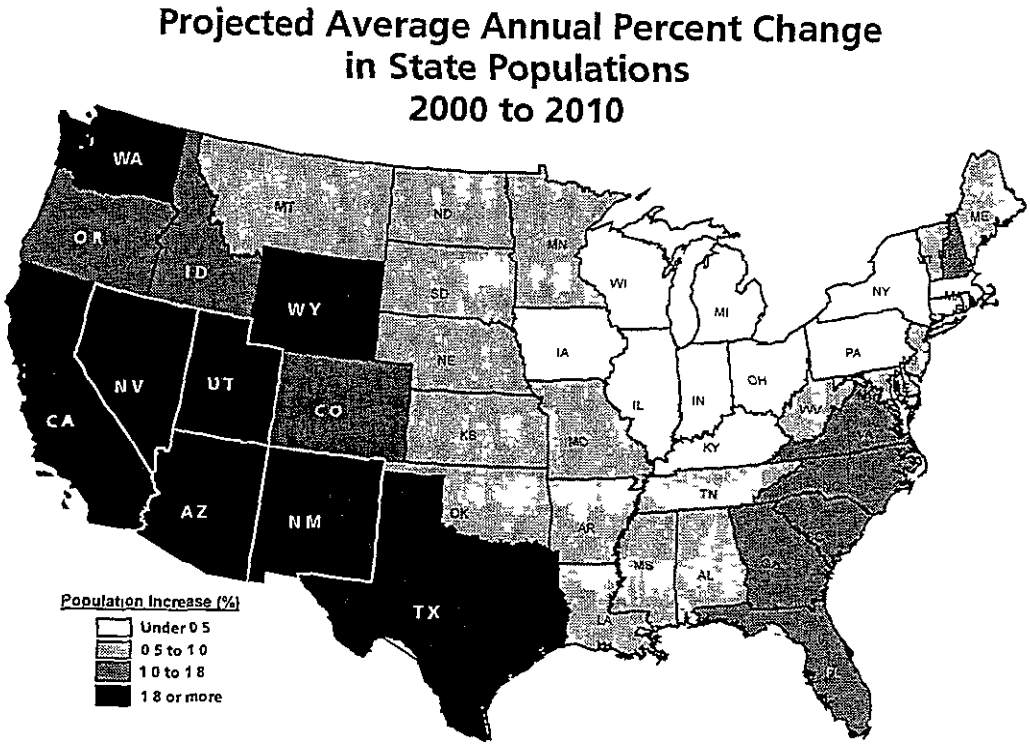


Figure 3-13.



Major Transportation Systems: An extensive interstate highway system that encircles and bisects the Province Starting north of Interstate 40 (I-40) in New Mexico, Interstate 25 (I-25) parallels much of the Province on its eastern boundary from New Mexico and Colorado through Wyoming until joining Interstate 90 (I-90) in Wyoming I-90 continues into Montana and eventually wraps around the northern end of the Province Interstate 15 (I-15) borders the area on its western boundary in Utah and continues into Idaho and eventually connects with I-90 in Montana Interstate 80 (I-80) bisects the Province in Wyoming and again in Utah Interstate 70 (I-70) bisects it in Colorado Since I-70 and I-80 bisect the Province, these portions of the transportation system may have some influence on animal movement

TRI-SECTION

Location and Area: The RGNF resides within the South-central Highlands Section (M331G) and the Southern Parks and Rocky Mountain Range Section (M331F) and was previously presented in Figure 3-5 The Forest abuts the Northern Rio Grande Basin Section (331J) (Bailey 1994) Because the Forest surrounds Section 331J, is appropriate to include it here for analysis Collectively, this area will be referred to as the Tri-Section A general description of the Tri-Section discussing geomorphology, lithology, stratigraphy, soils, potential natural vegetation, fauna, climate, surface water characteristics, disturbance regimes, land use, and cultural ecology, was presented earlier in this chapter The Tri-Section lies within southern Colorado and northern New Mexico Table 3-9 shows the Tri-Section acreage The Tri-Section (20 million acres) is 31% of the land area in the Province (65 9 million acres)

Table 3-9. Tri-Section Acreage

ECOLOGIC SECTION	ACREAGE
331J	3,873,300
M331F	4,891,700
M331G	11,180,800
TOTAL	**19,945,800**

Cover Types: The USDA Forest Service mapped the forested land as a part of the *Resources Planning Act* (RPA) 1993 assessment update (Powell et al 1993) Applying this information to the Tri-Section, the broad cover types and acreages are compared to the Province in Table 3-10

The dominant cover type in the Tri-Section is nonforested The major forested cover type is pinyon/juniper, followed by ponderosa pine and spruce/fir

The extreme-right-hand column of Table 3-10 gives a context for each cover type in the Tri-Section relative to the Province For example, ponderosa pine cover type comprises 3 2 and 5 2 million acres in the Tri-Section and Province, respectively Thus the Tri-Section represents the majority (62%) of the ponderosa pine cover type in the Province High percentages in the right-hand column mean high Tri-Section prominence The elm/ash/cottonwood, ponderosa pine and pinyon/juniper cover types in the Tri-Section comprise over 50% of the total acres in the Province Oakbrush, lodgepole pine, western hardwoods, and water account for less than 15% of the Province total

The public lands in the Tri-Section can heavily influence the future of elm/ash/cottonwood, ponderosa pine, spruce/fir, and pinyon/juniper within the Province. This is because the majority of these cover types is found in the Tri-Section Public lands could have some influence on Douglas-fir and aspen They would have limited influence on lodgepole pine, oakbrush, and western hardwoods

Table 3-10. Tri-section Cover Types and Acreages

COVER TYPE	Tri-Section Acres	Tri-Section Acres as a Percent of Province
Elm/ash/cottonwood (predominately cottonwood)	7,900	87%
Douglas-fir	753,700	20%
Ponderosa Pine	3,255,300	62%
Lodgepole Pine	217,500	2%
Spruce/fir (Engelmann spruce, subalpine fir, Colorado blue spruce)	2,395,200	27%
Oakbrush (Chaparral)	193,000	12%
Pinyon/juniper	4,221,000	52%
Western Hardwoods (predominately aspen and alder)	295,000	10%
Aspen/birch (predominately aspen)	393,200	19%
Nonforested	8,187,000	35%
Water	27,000	11%
TOTAL	19,945,800	

Age of Forested Cover Types: Age data are not available for the Tri-Section We assume that, by the dominant cover type, age classes are similar to those in the Province

Insects and Disease: According to the *Biological Diversity Assessment* done for this Region (USDA Forest Service, 1992), the Region as a whole is at moderate to high risk of insect epidemics, because of the large amount of older trees This same statement applies to the Tri-Section.

There have been a number of significant insect outbreaks in the Tri-Section over the past ten years. Ponderosa pine stands are subject to attack by mountain pine beetle (*Dendroctonus ponderosae*) In the mid- to late- 1980s the Uncompahgre Plateau experienced a major outbreak of the mountain pine beetle Hundreds of thousands of acres of pine trees were killed, and the ecological impact on the plateau is still apparent

Several ponderosa pine stands in the northwest portions of the San Juan NF are currently at risk to mountain pine beetle attack, although beetle populations have not reached the outbreak stage

Another major impact in the Tri-Section is the western spruce budworm (*Choristaneura occidentalis*) Stands of shade-tolerant Douglas-fir and true fir have increased tremendously in extent since the exclusion of fire in this century and these trees are the hosts of the spruce budworm A number of areas, including the western parts of the RGNF, the southern portions of the Gunnison NF and the eastern portions of the San Juan NF, were subject to severe budworm outbreaks in the late 1980s Not only was there widespread

mortality in the heavily hit stands, but the Douglas-fir beetle (*Dendroctonus pseudotsugae*) frequently killed the defoliated trees There have been no major outbreaks on the Santa Fe or Carson NFs over the last ten years

A final major outbreak in this area was that of the western tent caterpillar (*Malacosoma californicum*) south of Pagosa Springs, near the V-Rock area. Huge numbers of the caterpillar repeatedly defoliated extensive stands of aspen, which resulted in the destruction of many acres of aspen This outbreak was one of the largest ever recorded for the western tent caterpillar

Some organisms, notably the root diseases and the dwarf mistletoes, have extremely long-term effects It is difficult to predict precisely when and where they will cause problems The effect of diseases, in particular, tends to be extensive, rather then intensive, and the term "epidemic" is rarely applied to their activity

Timber Resource: Of the cover types listed above, Douglas-fir, ponderosa pine, lodgepole pine, and spruce/fir have the highest value for wood products Table 3-11 shows the total of these cover types

Table 3-11. Selected Tri-Section Cover Types

COVER TYPE	ACRES	PERCENT OF TOTAL
Douglas-fir	753,700	11%
Ponderosa Pine	3,255,300	49%
Lodgepole Pine	217,500	3%
Spruce/fir	2,395,200	36%
TOTAL	**6,621,700**	**100%**

Not all of these forested lands are available for timber harvest. Forest Service Land Management Plans within the Tri-Section show about 1,696,000 acres available This represents 26%of the forested lands that are present within the Tri-Section and 9% of the total Tri-Section acres Not all lands identified as available for timber harvest are treated in any one year or even in a decade We estimated that 3-5% of the forested lands would be affected in any one decade This means that, in the long term, up to about 26% of the forested lands could be altered by timber harvest The other 74% would change through natural processes of fire, insect and diseases, and growth and death

Livestock Grazing: Information is not available on how much of the Tri-Section is supporting domestic livestock grazing Of the total land base for the RGNF and the San Juan NF (both Forests are 1.8 million acres each), there are 881,250 acres (47% of the total) and 581,492 acres (31%) of suitable rangeland, respectively. An assumption is made here that the suitable rangeland for the rest of the Tri-Section is roughly 40% of the land base

Special Land Category: Special lands are Wilderness, roadless areas, Wild and Scenic Rivers, and National Park Service lands There are about 1,555,624 acres of Wilderness in the Tri-Section This represents 8% of the total lands within the Tri-Section There are 102 miles of designated Wild and Scenic Rivers. Table 3-13 gives a further breakdown of the Tri-Section special land categories; Wilderness and roadless areas are the majority.

Table 3-12. Tri-Section Recreation Use

STATE/FOREST	TOTAL RVDs (1000'S)
Colorado	
Grand Mesa-Uncompahgre-Gunnison	4,931 0
Pike-San Isabel	6,928 0
Rio Grande	**1,275.9**
San Juan	1,707 0
New Mexico	
Carson	1,715 0
Santa Fe	2,830 1
TOTAL	19,387 0

Recreation: Table 3-12 shows recreation use on Forest Service lands only within the Tri-Section The recreation use shown is for a slightly larger area than the Tri-Section, since National Forest boundaries do not follow the Tri-Section boundary The Pike-San Isabel NF has the highest recreation use The total RVD's for the Tri-Section are 21% of the total RVDs for the Province. The Tri-Section is 31% of the land area in the Province This means that other areas in the Province are receiving disproportionately more recreation use than the Tri-Section

More detailed recreation data, by special-land category (Wilderness; roadless area, or National Park, Monument, or Recreation Area), is presented in Table 3-13

Table 3-13. Summary of Ownership and Acres and Recreation Use for the Tri-Section

OWNERSHIP	SPECIAL LAND CATEGORY	ACRES	RVD's [2]	RVD's/Acre
Federal [1]	Wilderness	1,555,624	815,800	5
Forest Service	Roadless Area	1,696,861	9,288,800	5 5
Bureau of Land Management	Roadless Area	392,478	1,474,200	3 8
National Park Service	Park or Monument	126,700	1,435,400	11 3
National Park Service	Recreation Area	40,000	1,011,100	25 3
TOTAL		**3,811,663**		

1 Forest Service and Bureau of Land Management lands
2 One RVD is equal to 12 hours of recreation for one person, or one hour of recreation for 12 persons, or any combination thereof

National Park Service lands receive the most recreation use per unit of land In fact, the use per unit of land is higher than the per unit use in the Province Roadless-area use is the next highest, and Wilderness the least These trends match those in the Province (see pg 3-27)

Rare Species: Based on the Biological and Conservation Database of the Colorado Natural Heritage Program (CNHP), known occurrences of special-status species (defined below) for

the RGNF were compiled for the Province and Tri-Section To incorporate the most recent information, in April 1994 the Forest gathered knowledgeable people and have them describe what they knew about particular species occurrence on the Forest and surrounding areas of the Tri-Section The result was an additional 451 records for the Tri-Section and Forest

For the Tri-Section analysis, a species needed to meet three criteria in order to be displayed below reliable documentation of occurrence on the RGNF (and therefore occurrence within the Tri-Section), reliable documentation of historical occurrence on the RGNF (and therefore occurrence within the Tri-Section), and species listed as either Threatened or Endangered by the US Fish and Wildlife Service, or 4) species listed as Candidate (or Category 1 or Category 2, in the old system) by the US Fish and Wildlife Service; or a species designated Sensitive by the Rocky Mountain Region of the Forest Service Table 3-14 presents a numerical context (where available) for each species meeting these criteria

The CNHP occurrence records are based on records documented to date, and are highly reliable information Some species are more well documented than others Some (e.g , marten and goshawk) have so many sightings that the CNHP does not track their occurrence Other species are poorly documented due to low search efforts (see Appendices F and G for further information on the search effort status of Threatened, Endangered, and Sensitive species) Thus some discretion in interpretation has to be used for each species

Species with a high Tri-Section occurrence (90% or higher) relative to the Province are as follows: Rio Grande Chub, Rio Grande cutthroat, Brandegee milkvetch, Ripley milkvetch, Smith whitlow-grass, and rock-loving neoparrya Thus these species are especially significant within the Tri-Section For example, consider the American peregrine falcon and the Rio Grande cutthroat trout The former has a Tri-Section abundance of 10%, versus 100% for the latter This means the Tri-Section is highly significant for the Rio Grande cutthroat trout, but much less significant for the American peregrine falcon, based upon documented records Where there are no documented numbers (for example, northern leopard frog), the importance of the Tri-Section is much less clear Data are insufficient for those species listed above where occurrence is listed as "Yes "

Table 3-14. RGNF Special-Status Species occurrence within the Tri-Section and Province

PLANTS	PROVINCE	TRI-SECTION [2]	TRI-SECTION ABUNDANCE % [1]
Brandegee milkvetch (*Astragalus brandegei*)	5	5	100%
Ripley milkvetch (*Astragalus ripleyi*)	42	42	100%
echo moonwort (*Botrychium echo*)	17	4	24%
pale moonwort (*Botrychium pallidum*)	5	3	60%
Smith whitlow-grass (*Draba smithii*)	8	8	100%
Brandegee wild buckwheat (*Eriogonum brandegei*)	8	3	38%
Black Canyon gilia (*Gilia penstemonoides*)	unknown	22	unknown
Colorado tansyaster (*Machaeranthera coloradoenses*)	unknown	15	unknown
Altai cottongrass (*Eriophorum altaicum* var *neogaeum*)	12	10	83%
rock-loving neoparrya (*Neoparrya lithophila*)	12	11	92%
ANIMALS			
goshawk (*Accipter gentilis*)	Yes	Yes	Unknown
boreal owl (*Aegolius funereus*)	65	13	39%
tiger salamander (*Ambystoma tigrinum*)	Yes	Yes	Unknown
boreal toad (*Bufo boreas boreas*)	145	21	14%
gray wolf (*Canis lupus*)	Yes	Yes	Unknown
olive-sided Flycatcher (*Contopus borealis*)	*Yes	Yes	Unknown
black swift (*Cypseloides niger*)	9	6	37%
American peregine falcon (*Falco peregrinus anatum*)	22	2	10
lynx (*Felis lynx canadensis*)	190	3	2%
wolverine (*Gulo gulo*)	81	4	5%
bald eagle (*Haliaeetus leucocephalus*)	Yes	Yes	Unknown
loggerhead shrike (*Lanius ludovicianus*)	3	1	33%
marten (*Martes americana*)	Yes	Yes	Unknown
Lewis' woodpecker (*Melanerpes lewis*)	Yes	Yes	Unknown
Rio Grande Chub (*Oila pandora*)	2	2	100%
Rio Grande cutthroat (*Oncorhynchus clarki virginalis*)	33	33	100%
flammulated owl (*Otus flammeolus*)	Yes	Yes	Unknown
osprey (*Pandion haliaetus*)	Yes	Yes	Unknown
fox sparrow (*Passerella iliaca*)	Yes	Yes	Unknown
three-toed woodpecker (*Picoides tridactylus*)	Yes	Yes	Unknown
Townsend's big-eared bat (*Plecotus townsendii*)	Yes	Yes	Unknown
northern leopard frog (*Rana pipiens*)	Yes	Yes	Unknown
golden-crowned kinglet (*Regulus satrapa*)	Yes	Yes	Unknown
pygmy nuthatch (*Sitta pygmaea*)	Yes	Yes	Unknown
Mexican spotted owl (*Stix occidentalis lucida*)	Yes	Unknown	Unknown
grizzly bear (*Ursus arctos*)	64	25	39%

1 Tri-Section occurrence divided by Province occurrence
2 Number of known occurrences

Air Quality: Air quality problems are less severe at the Tri-Section level than for the whole Province. Major pollution sources are not extensive within this area, and upwind-pollution sources are not as concentrated

The Tri-Section has portions of three airsheds identified in the Forest Service Rocky Mountain Region air-quality assessment Major pollution sources whose impacts are increasing include power plants (sulphur dioxide—SO2 and nitrogen oxides—NOx) and oil/gas activities (SO2, NOx, particulate matter—PM and carbon monoxide—CO)

Three counties, San Miguel, Archuleta, and Fremont, are experiencing violations of National air-quality standards All three have areas violating the standard for particulate matter All are within or touch the Tri-Section

Water: Aquatic resources are best assessed by watersheds. The Tri-Section is composed of portions of many different watersheds that are not connected hydrologically Rather than consider water by Tri-Section, the evaluation will be done for the Rio Grande drainage area within Colorado

There is far more demand for available water than can be supplied To help alleviate this problem, the Bureau of Reclamation developed the Closed Basin Project Through this project, some water that would be lost to evapotranspiration in the Closed Basin is captured by wells and delivered to the Rio Grande.

Off-Forest pollution sources in Colorado are related primarily to agriculture The San Luis Valley has a large irrigated agricultural industry Irrigation return flows carry some level of pollution back into the River Best management practices are used by most San Luis Valley farmers, and consequently, water leaving the state is meeting all state standards

Population: The listed counties in table 3-15 are within or overlap the Tri-Section The table shows their 1980 and 1990 populations and the percent change over the ten-year period.

The average population change for all 30 affected counties was +10% This is the same average growth as in the Province.

The New Mexico portion of the Tri-Section is growing 3 ½ times faster than the Colorado portion

Counties with growth rates are Archuleta (CO), Custer (CO), Sandoval (NM), Santa Fe (NM), and Taos (NM) Thus the highest growth rates in Colorado are in the Pagosa Springs and Westcliffe areas The highest in New Mexico are in the Albuquerque, Santa Fe, and Taos areas

Counties with the highest concentration of people (over 50,000 people) are Mesa (Grand Junction area), Pueblo (Pueblo area), Sandoval (between Albuquerque and Santa Fe), and Santa Fe (Santa Fe area) Thus the northwest corner, northeast corner, and the whole southern portion of the Tri-Section have the highest concentrations of people

Figure 3-14 on the next page shows the population density for the Tri-Section area of Colorado and New Mexico.

Transportation System: Interstate 25 borders the Tri-Section on the eastern boundary and wraps around the southern boundary (See Figure 3-15) Extensive U.S highway system encircles and bisects the Tri-Section, as follows Highway 50 borders the northern portion. Highway 550 bisects the northern portion north-south from Montrose to Durango Highway 160 bisects the northern portion east-west from Walsenburg to Durango Highway 285 bisects the entire area north-south from Salida to Santa Fe. Highway 64 bisects the southern portion east-west from Raton to Chama Highway 84 bisects the southern portion north-south from Pagosa Springs to Santa Fe

Table 3-15. Population Growth Rate for the Tri-Section

STATE/COUNTY	1980 CENSUS	1990 CENSUS	% Change
Colorado			
Alamosa	11,799	13,617	15
Archuleta	3,664	5,345	46
Conejos	7,794	7,453	- 4
Costilla	3,071	3,190	4
Custer	1,528	1,926	26
Dolores	1,658	1,504	- 9
Fremont	28,676	32,273	13
Gunnison	10,689	10,273	- 4
Hinsdale	408	467	14
Huerfano	6,440	6,009	- 7
La Plata	27,424	32,284	18
Las Animas	14,897	13,765	- 8
Mesa	81,530	93,145	14
Mineral	804	558	-31
Montezuma	16,510	18,672	13
Montrose	24,352	24,423	3
Ouray	1,925	2,295	19
Pueblo	125,972	123,051	- 2
Rio Grande	10,511	10,770	2
Saguache	3,935	4,619	17
San Juan	833	745	-11
San Miguel	3,192	3,653	14
Counties within or touching the RGNF are in bold font		Average	+ 6%
New Mexico			
Colfax	13,706	12,925	-6
Los Alamos	17,599	18,115	3
Mora	4,205	4,264	1
Rio Arriba	29,282	34,365	17
Sandoval	34,799	63,319	82
San Miguel	22,751	25,743	13
Santa Fe	75,306	98,928	31
Taos	18,862	23,118	23
		Average	+21%

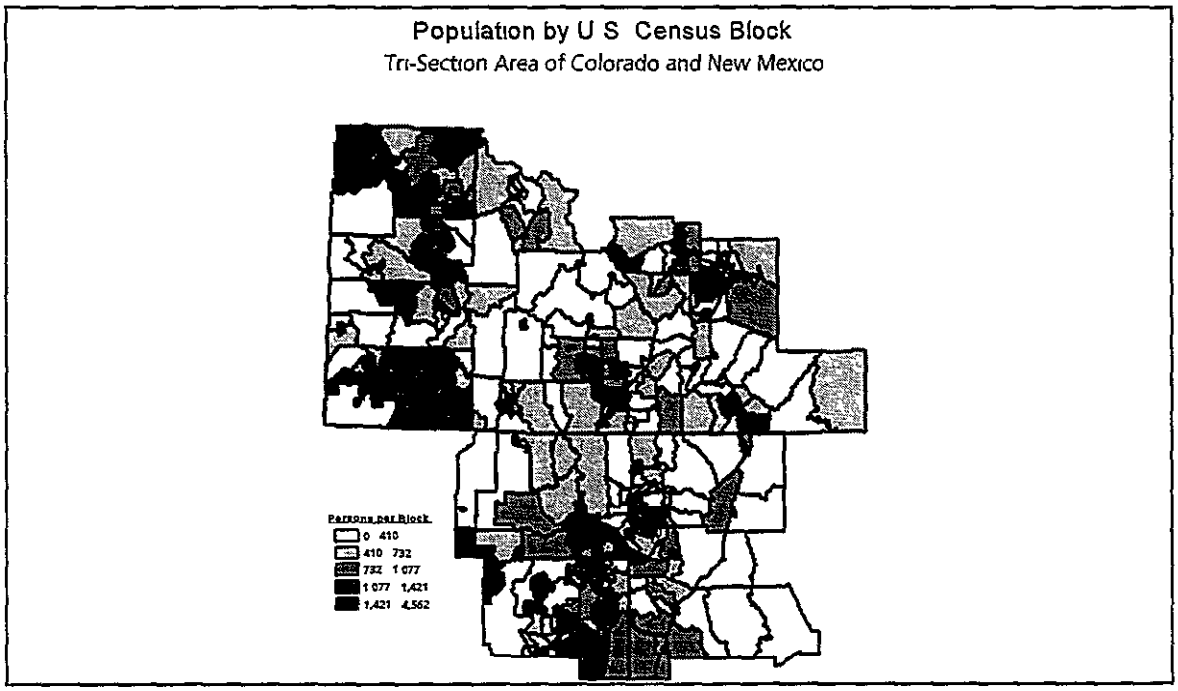


Figure 3-14. Population within the Tri-Section Area

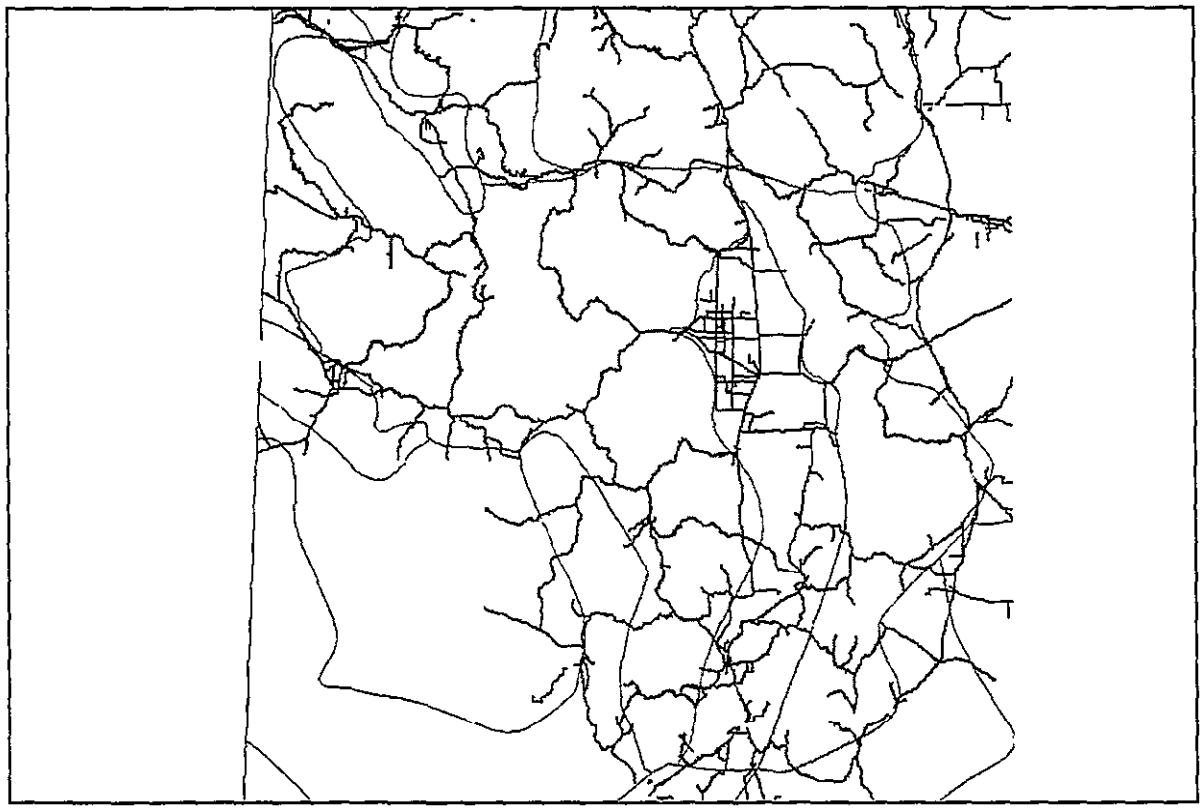


Figure 3-15. Major Roads in the Tri-Section Area

FOREST

Landtype Associations

Sections are subdivided into Landtype Associations (LTAs) LTAs are based on similarities in geology, soils, and plant associations. Repeatable patterns of soil complexes and plant communities are useful in delineating map units at this level LTAs are an appropriate ecological unit to use in Forest- or area-wide planning and watershed analysis (ECOMAP, 1993). On the RGNF, soil mapping units were aggregated into 13 distinct LTAs See Figure 3-18

LTA 1 - Engelmann Spruce on Mountain Slopes
LTA 2 - Aspen on Mountain Slopes
LTA 3 - White Fir and Douglas-Fir on Mountain Slopes
LTA 4 - Alpine Sedges and Forbs on Alpine Summits
LTA 5 - Ponderosa Pine and Douglas-fir on Mountain Slopes
LTA 6 - Pinyon on Mountain Slopes
LTA 7 - Gambel Oak on Mountain Slopes
LTA 8 - Arizona Fescue on Mountain Slopes
LTA 9 - Thurber Fescue on Mountain Slopes
LTA 10 - Willows and Sedges on Floodplains
LTA 11 - Nonvegetated Areas on Mountain Slopes
LTA 12 - Western Wheatgrass and Other Low-Elevation Grasslands on Alluvial Fans
LTA 13 - Engelmann Spruce on Landslides

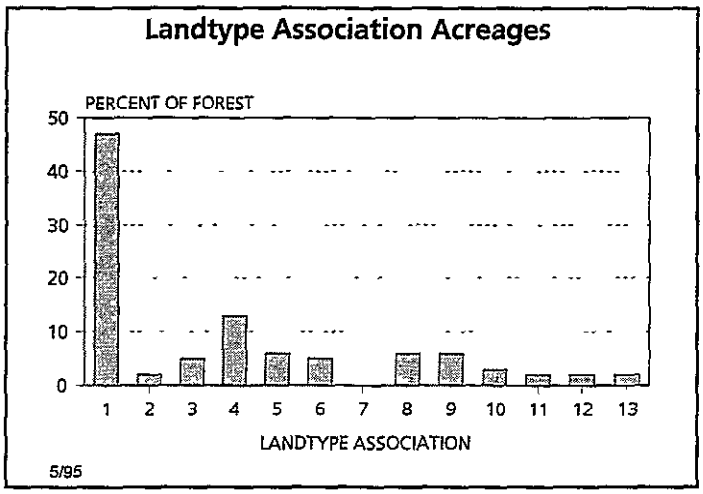


Figure 3-16. Landtype Association Acreages

Each LTA is described in detail below. The components of the descriptions are.

* **Setting:** This section is an overview and characterization of the LTA Ranges of slope, elevation, average annual precipitation, and soil depth are given The dominant long-term vegetation (potential natural community) that will occupy the site is described Finally, the total acreage is given. (LTA acreages as a percentage of the Forest are displayed in Figure 3-16.)

* **Landform, Slope, Geology, and Soils:** This section discusses these aspects of LTAs Further detail concerning the terminology and descriptions can be found in the Soil Survey for the RGNF, on file at the Forest Headquarters.

* **Composition:** This section contains the following components existing habitat dominants, potential natural community, and ecological condition

* **Existing habitat dominants:** A pie chart shows the generalized vegetation and nonvegetative dominants for the LTA The term "existing" is important to distinguish from "potential," as used below. Existing habitat dominants refer to the vegetation, rock, or water that is currently occupying and dominating the LTA.

* **Potential Natural Community:** This section describes the general vegetative community that would develop if all successional sequences were completed under present site conditions Natural disturbance processes (for example, wildfire, windstorms, floods, and insect and disease outbreaks) interrupt succession and create conditions for renewed growth and colonization. The frequency of natural disturbance processes influences and shapes the potential natural community

  More specifically, this potential natural community is conceptually called a "plant association." Plant associations are a kind of plant community represented by stands occurring in places where environments are so closely similar that there is a high degree of floristic uniformity in all layers. Because LTAs are aggregations of soil mapping units, the LTA may contain several plant associations

  The stages depicted are existing plant community dominants for some temporal period The terms early, mid, and late loosely depict a successional sequence The end result is an expression of the potential natural community

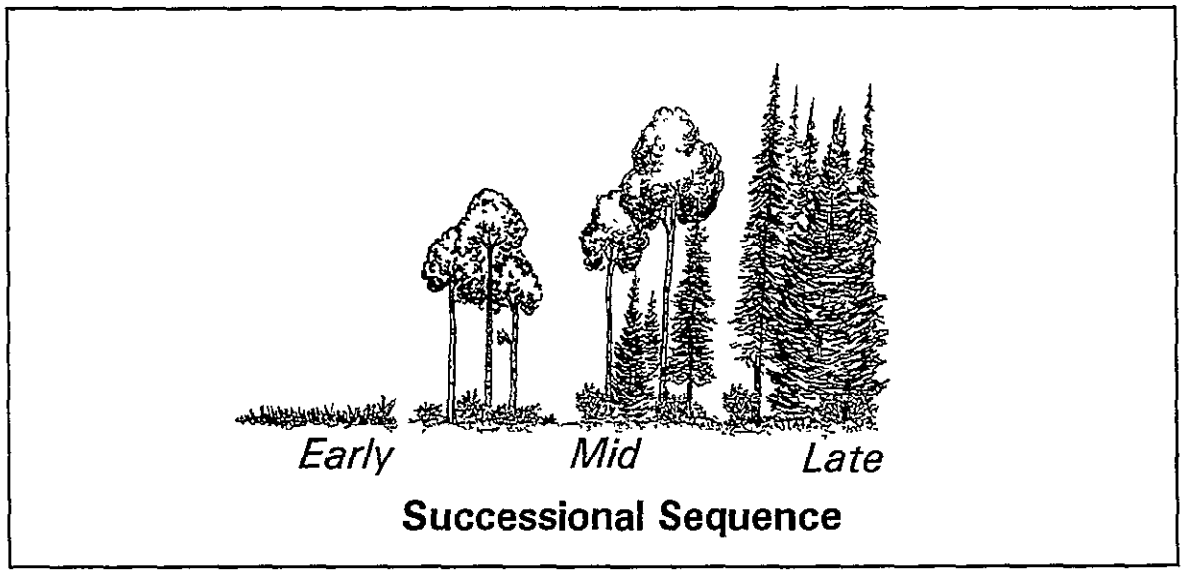


Figure 3-17. Successional Sequence

This section also describes inclusions, which are other plant associations and nonvegetated areas found within the LTA (If the LTA were a chocolate chip cookie, the cookie would be the potential natural community; the chocolate chips would be the inclusions.)

* **Ecological Condition:** A pie chart depicts a general interpretation of the LTAs ecological condition The condition is determined by evaluating the extent of existing habitat dominants relative to the potential natural community for the LTA Because the data available are very general, this interpretation can be made only for

forested LTAs The classification system uses the terms early, mid, and late, which depict a phase in the sequential development of a plant community

* **Structure:** There are two spatial scales of structure, one is within stand structure (defined here as Structure Class) and the other is the pattern on the landscape

  * **Structure Class:** This is a size and canopy-closure classification for forested LTAs and is outlined below

Structure Class	Habitat Structural Stage	Description
(1)	1,2	GRASS/FORB/SHRUB/SEEDLING Stand dominance by grasses, forbs (broad-leaved herbaceous plants), shrubs and/or tree seedlings up to 1" Diameter at Breast Height (DBH)—4 5 feet DBH for softwoods and 2" DBH for hardwoods
(2)	3a	SAPLING-POLE Stand dominance by trees in the majority of the 1-8 9" DBH size for softwoods and 2-8.9"DBH for hardwoods with a canopy closure of less than or equal to 40%
(3)	3b,3c	SAPLING-POLE Same as (2) except canopy closure is 41-100%.
(4)	4a	MATURE Stand dominance by trees in the majority of the 9" or larger DBH size and tree age less than 200 years for softwoods and less than 100 years for hardwoods Canopy closure is 40% or less
(5)	4b,4c,5	LATE-SUCCESSIONAL FOREST Two conditions are possible for meeting this category

Stand dominance by trees in the majority of the 9" or larger DBH size and tree age less than 200 years for softwoods and less than 100 years for hardwoods Canopy closure is greater than 40%

Stand dominance by trees in the 5" DBH or greater size with a tree age more than 200 years for softwoods and more than 100 years for hardwoods Tree crown cover is more than 70 percent

The definition of "old growth" changed in the Rocky Mountain Region with the publication of a paper by Mehl (1992) Structure Class 5 is an approximation of old growth on the Forest, according to this definition.

  * **Landscape Pattern:** This section refers to the LTA map (Figure 3-18) the spatial distribution of the LTAs across the Forest

* **Process:** This section discusses ecological process, where information exists, for the following fire, insects and disease, production, and nutrient cycling

  * **Fire:** Relevant literature on the fire-return interval and the general magnitude of fires, by LTA, with a specific estimate for the RGNF. Heinselman's fire regimes were used to characterize each LTA

* **Insects, Disease, and Other Natural Disturbances:** The insect and disease activity associated with the LTA

* **Production:** The site index (a quantitative evaluation of soil productivity for forest growth under the existing environment—usually expressed as height in feet at 100 years of age) for trees and the herbaceous production in pounds per acre are provided

d) Nutrient Cycling: A discussion of nutrient cycling is provided

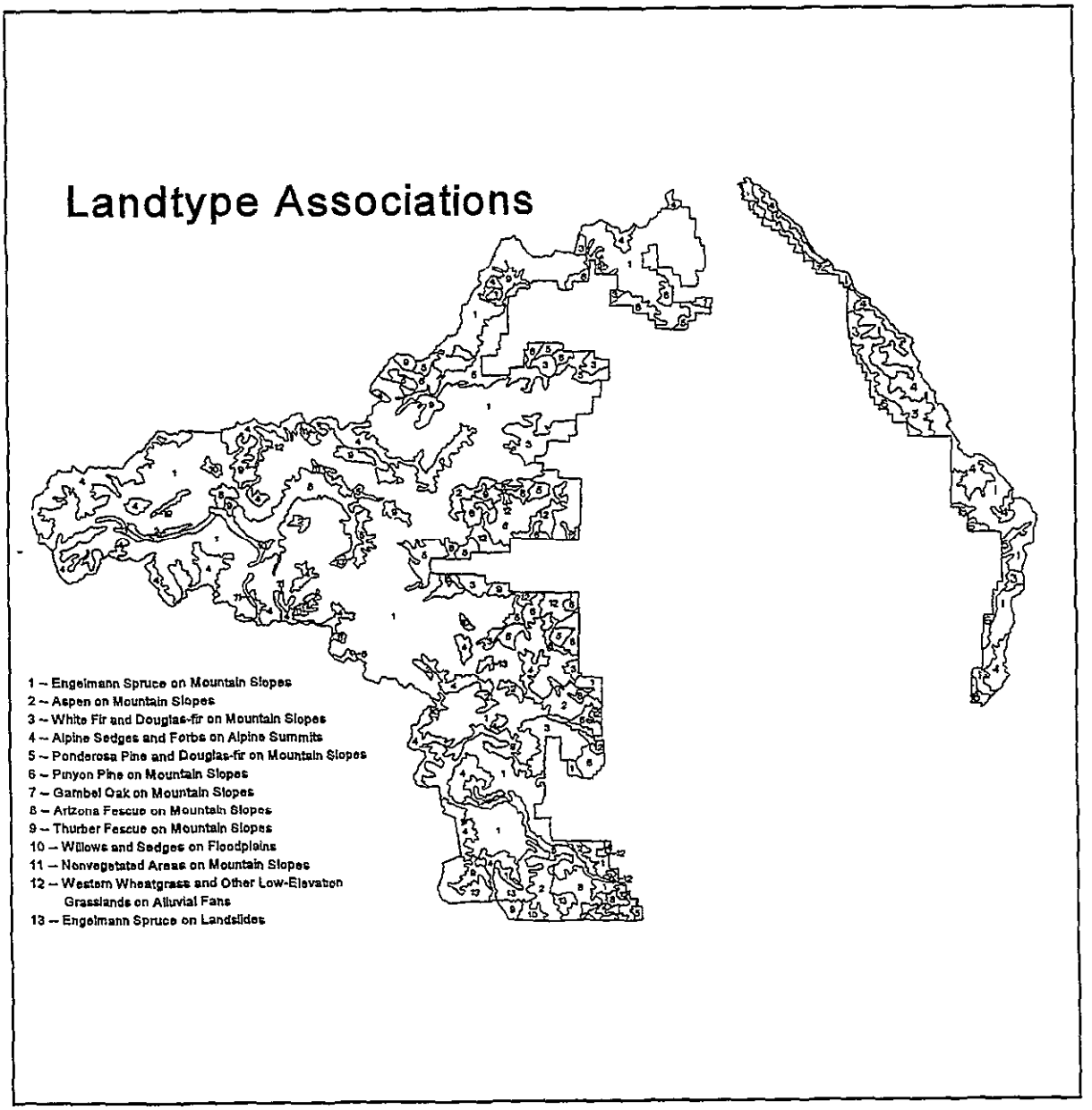
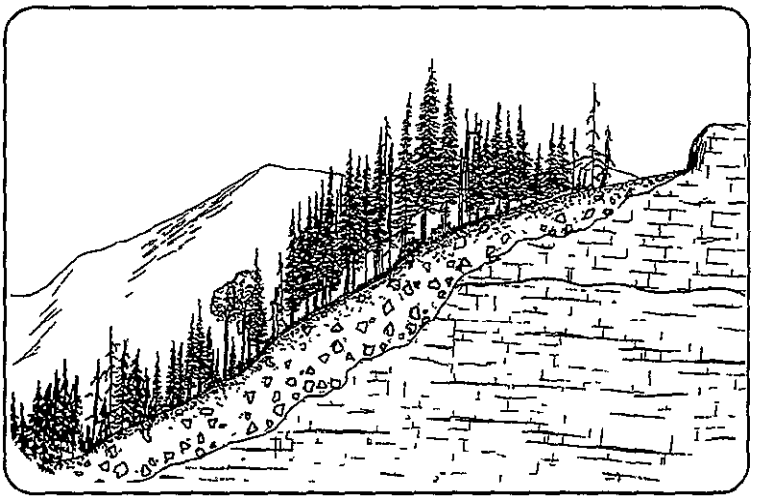


Figure 3-18. Map of Landtype Associations

LTA 1–Engelmann Spruce on Mountain Slopes

SETTING: Engelmann spruce dominates this LTA, which occurs on gentle to very steep mountain slopes at elevations of 8,600-12,000 feet The average annual precipitation is from 16-40 inches. Soils are generally shallow to very deep The LTA comprises about 893,000 acres (49%) of the RGNF



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA occurs on mountain slopes and consists of more detailed units having gentle, moderate, steep, and rugged mountain slopes Mountain slopes typically have a ridge or summit, shoulder slope, backslope, toeslope, and footslope Slopes range from nearly level to more than 60 percent In the San Juan Mountains, the LTA occurs on colluvium and residuum derived from volcanic rocks In the Sangre de Cristo Mountains, the LTA occurs on metamorphic and sedimentary rocks

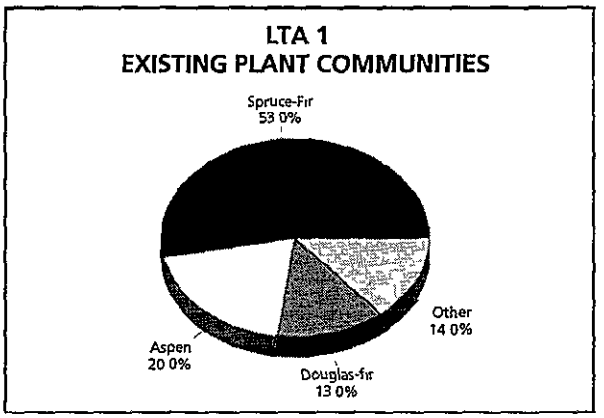
Granile soils comprise about 19%, Seitz soils 18%, and Leighcan soils 15%. These soils are very deep and well drained, and have considerable rock fragments. The erosion hazard is moderate to high Mass-movement potential is very low to low. Other significant soil types include Agneston (7%), Endlich (6%), Rock Outcrop (5%), Tellura (4%), Hechtman (3%), Peregrine (2%), Winz (2%), and Scout (2%)

COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community

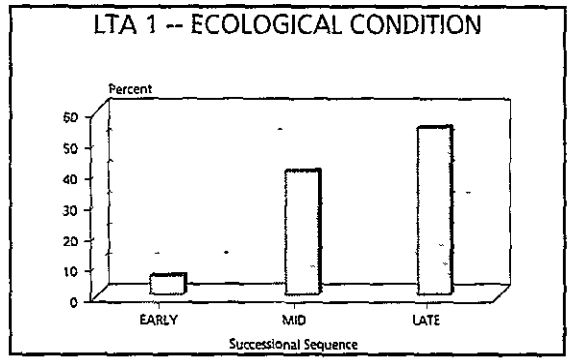
Potential Natural Community: The three major plant associations that predominate are

- Subalpine fir-Engelmann spruce/Rocky Mountain whortleberry
- Subalpine fir-Engelmann spruce/common juniper



Subalpine fir-Engelmann spruce/Rocky Mountain whortleberry, Polemonium phase

Inclusions: Because this LTA covers such an extensive area on the Forest, there are a number of included plant associations and nonvegetated areas The largest inclusions are Rock outcrop and rubble land, Thurber fescue grasslands, willows, sedges, and other wetland plants



Ecological Condition:

Early 6%
Mid: 40%
Late 54%

STRUCTURE:

Structure Class: The majority of the acreage is in Structure Class 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA	10%	4%	15%	10%	60%	100%

Landscape Pattern: See LTA map

PROCESS:

Fire: Engelmann spruce has variable fire frequencies. Studies have shown fire frequencies ranging from 63 to 400 years in interval (Arno 1980, Romme 1979, Scott 1981, Alexander 1987) Engelmann spruce has thin bark and dead-lower-limb persistence that make it susceptible to fires and easily killed even by low-intensity fires Post-fire reestablishment is via wind-dispersed seeds, which readily germinate on fire-prepared seedbeds Many Engelmann spruce stands are even-aged, suggesting that they developed after fire Subalpine fir is extremely susceptible to ground and crown fires, because it has thin bark, and is resinous, and the narrow crown usually extends to the ground (Fowells 1965)

Engelmann spruce/Subalpine fir forests are usually characterized by Heinselman's Fire Regime 4 in the lower-elevation moister sites or Regime 6 for the higher-elevation moister areas (Mutch 1990) characteristics of Regime 4 are crown fires with short to medium-length return intervals and severe surface fires, in combination (50-200 year return intervals) Most stand elements are killed over large areas. Fires range from 5,000 to 100,000 acres in size. Heinselman's Fire Regime 6 is characterized by crown fires with very long return-interval and severe surface fires, in combination (over 300-year return intervals) (Mutch 1990)

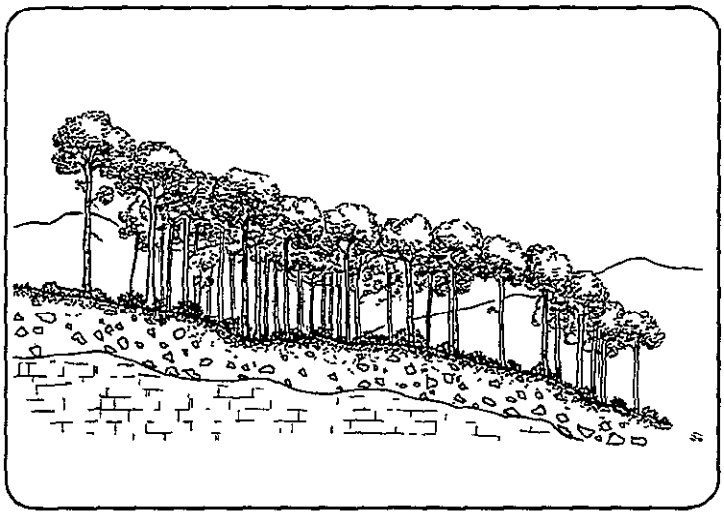
Insects, Disease, and Other Natural Disturbances: Spruce beetle is the most serious insect pest of mature and over-mature Engelmann spruce Six large-scale outbreaks of spruce beetle have occurred in the southern Rocky Mountains since the mid-1800s (Baker and Veblen 1990) The western spruce budworm, a defoliator, also causes considerable damage to Engelmann spruce and subalpine fir (Lynch and Swetnam 1992) Return intervals for the

western spruce budworm in Colorado and New Mexico are approximately 30 to 40 years (Swetnam and Lynch 1989). Other significant insect pests of subalpine fir are the black-headed budworm and the western balsam bark beetle (Fowells 1965). Wood-rotting fungi are the most common diseases in Engelmann spruce and subalpine fir (Fowells 1965)

Potential Production: The potential timber productivity site index for the major soil types is 35 to 85 for Engelmann spruce (base age 100 years) Range productivity based on grasses, forbs, and annual twig growth of shrubs for the major soil types (in air-dry pounds per acre per year) range from 25 to 100 in an unfavorable year, from 50 to 150 in a normal year, and from 75 to 250 in a favorable year

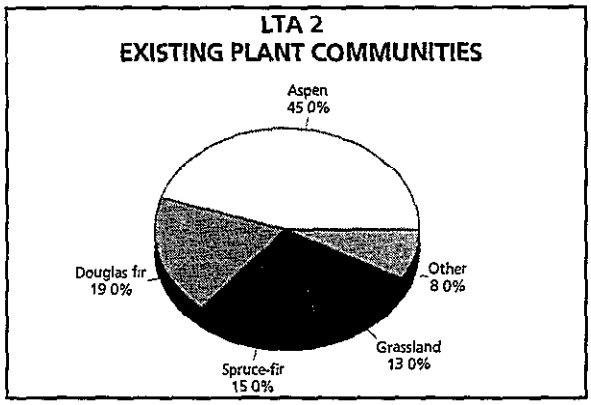
Nutrient Cycling: These ecological sites are generally nitrogen deficient Organic matter provides nitrogen and other nutrients at slow release rates because of cold soil temperatures. Decomposition processes are relatively slow for large woody materials, which may persist for 100 years Leaves and small branches decompose in about 5 years

LTA 2–Aspen on Mountain Slopes



SETTING: Climax aspen dominates this LTA, which occurs on moderate to steep mountain slopes at elevations of 9,000 to 11,000 feet The average annual precipitation is from 18 to 30 inches. Soils are generally shallow to moderately deep The LTA comprises about 39,121 acres (2%) of the RGNF

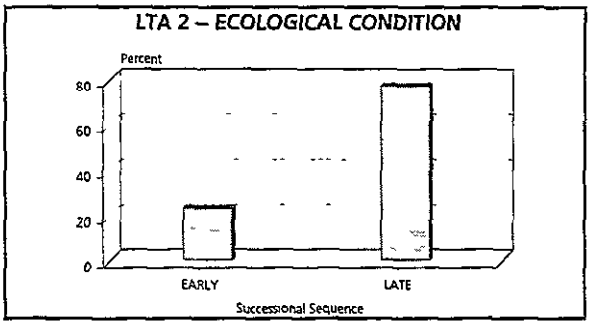
LANDFORM, SLOPE, GEOLOGY AND SOILS: The LTA occurs on moderate to steep mountain slopes with generally south and west-facing aspects. Slopes range from 15 to 60 percent Volcanic breccias, andesites, and rhyolites are the primary rock types Bowen moist soils comprise about 64%, with Agneston 17% These soils are moderately deep, well drained, and have considerable rock fragments The erosion hazard is moderate to high Mass-movement potential is low Bushvalley soils are shallow to bedrock, well drained, and have considerable rock fragments, they comprise 4%.



COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community

Potential Natural Community: The potential natural community is aspen/Thurber fescue. There are some inclusions of subalpine fir-Engelmann spruce/common juniper, Arizona fescue/mountain muhly, Arizona fescue/Thurber fescue, subalpine fir-Engelmann spruce/Rocky Mountain whortleberry, ponderosa pine/fescue and pinyon/blue grama



Ecological Condition:

Early 23%
Late· 77%

STRUCTURE:

Structure Class: The majority of the acreage is in Structure Class 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA	18%	8%	25%	10%	38%	100%

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: Fire has played an important role in the establishment and maintenance of aspen forests (Brown and Simmerman 1986) Although aspen appears to represent climax vegetation in parts of the West, in many areas it grows as a seral species, which means it depends on fire or other major disturbance for regeneration. The natural stand-replacement fire interval in many western aspen/mixed-conifer or spruce/fir communities was approximately 70 to 200 years (Covington et al 1983) Low-intensity fires may have occurred at 2 to 5 year intervals in some western, lower elevation aspen/bunch grass communities (Covington et al 1983) Before the late 1800s, fire frequencies were about every 6 years in Jackson Hole, Wyoming (Loope and Gruell 1973) and every 7 to 10 years in Central Utah (DeByle and Winokur 1985) "For Colorado aspens, Hendrickson (1972) hypothesizes that "the pre-settlement fire regime was one of long return-interval (50 to 150 years) seral surface fires (crowning is rare in nearly pure aspen)" (Crane 1982) Few aspen fire scars in Colorado date later than 1880 (Davidson et al. 1959). Research indicates that fire frequencies of 100 to 300 years are necessary for the regeneration and maintenance of many aspen communities (Covington et al 1987)

The fire regime of aspen falls into Heinselman's Fire Regime 4 which is characterized by short- to medium-length return-interval crown fires and severe surface fires in combination (50-200 year return intervals) (Mutch 1990) Most stand elements are killed over large areas, and fire size ranges between 5,000 and 100,000 acres (Mutch 1990)

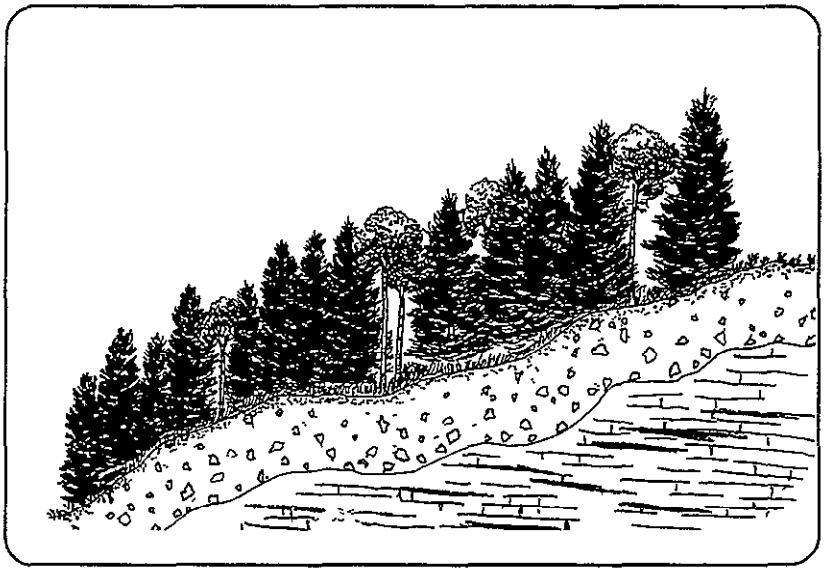
Insects, Disease, and Other Natural Disturbances: Aspen forests seldom burn due to a shortage of fine fuels (DeByle and Winokur 1985) Due to aspens thin green skin, very light fires can kill aspen suckers or cause basal scarring that leads to heart rot (Baker 1925) Wood-rotting fungi and canker-causing fungi are the most common diseases in aspen Western tent caterpillar, poplar borer, poplar twig saperda, flatheaded wood borer, and three species of leafhoppers cause major damage to aspen in Colorado (Boss 1972)

Potential Production: The potential timber productivity site index for the major soil types is 30 to 40 for aspen (base age 80 years) Range productivity based on grasses, forbs, and annual twig growth of shrubs for the major soil types (in air-dry pounds per acre per year) ranges from 100 to 800 in an unfavorable year, from 200 to 1,500 in a normal year, and from 400 to 2,000 in a favorable year. Shallow soils like Bushvalley have the lower production, while the moderately deep Bowen soil has the higher production levels

Nutrient Cycling: These ecological sites may be nitrogen deficient Organic matter provides nitrogen and other nutrients at moderate release rates because of cold soil temperatures Decomposition processes are somewhat more rapid for large woody materials, which may persist for 25 to 50 years Leaves and small branches decompose in about 1 to 3 years

LTA 3– White Fir and Douglas-Fir on Mountain Slopes

SETTING: White fir and Douglas-fir dominate this LTA, which occurs on gentle to very steep mountain slopes at elevations of 8,000 to 11,000 feet The average annual precipitation is from 12 to 30 inches Soils are generally moderately deep to very deep The LTA comprises about 93,000 acres (5%) of the RGNF

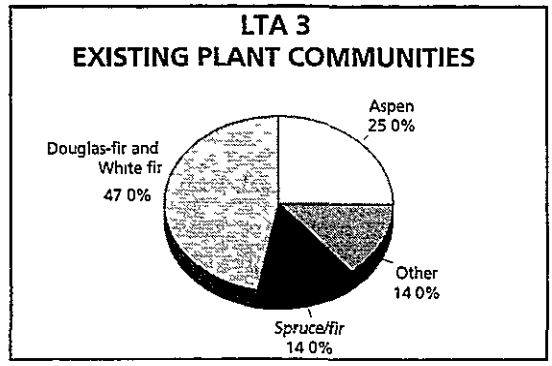


LANDFORM, SLOPE, GEOLOGY AND SOILS: The LTA occurs on gentle to very steep mountain slopes ranging from 2 to 80 percent Geology consists of breccias, rhyolites, and andesites in the San Juan mountains, and some metamorphic rocks in the Sangre de Cristo mountains Seitz soils comprise 42%, with Pergrin 17%, and Embargo 14% Seitz soils are very deep and well drained, and contain considerable rock fragments These soils have clayey subsoils Pergrin and Embargo soils are moderately deep and well drained and also have considerable rock fragments The erosion hazard is moderate to high Mass-movement potential is very

low to low Other soils include Tellura (6%), Condie (3%), and Sambrito (2%) Rock Outcrop, Dune land, Leal, and Leighcan each comprise less than 2%.

COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community.

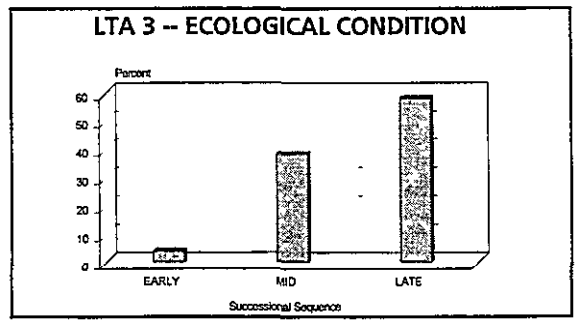


Potential Natural Community: The following potential natural communities occur in this LTA.

white fir-Douglas-fir/common juniper
white fir-Douglas-fir/Gambel oak
white fir-blue spruce/sedge
white fir-Douglas-fir/alder
white fir-Douglas-fir/Rocky Mountain maple
white fir-Douglas-fir/kinnikinnick
white fir-Douglas-fir/sparse understory
Douglas-fir/currant-Arizona fescue
Douglas-fir-white fir/sparse understory
Douglas-fir-white fir/sedges
Douglas-fir/sparse understory
white fir-blue spruce/mountain snowberry
white fir/kinnikinnick
white fir-Douglas-fir/common juniper-sedge
white fir-Douglas-fir/kinnikinnick-common juniper
white fir-Douglas-fir/Rocky Mountain whortleberry-heartleaf arnica

Inclusions:

Bristlecone pine/Arizona fescue
pinyon/Gambel oak
ponderosa pine/Ariz fescue-Parry oatgrass
ponderosa pine/Gambel oak
Engelmann spruce/sidebells pyrola
narrowleaf cottonwood/forbs
aspen/Porter ligusticum-spreading golden banner
subalpine fir-Engelmann spruce/Rocky Mountain whortleberry



Ecological Condition:

Early 4%

Mid 38%

Late 58%

STRUCTURE:

Structure Class: The majority of the acreage is in Structure Classes 3 and 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA	6%	5%	22%	8%	59%	100%

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: Pre-settlement fire frequency in mixed-conifer forests of the central and southern Rocky Mountains was from 7-22 years (Appendix A) This falls into Heinselman's Fire Regime 2 which is characterized by frequent, light surface fires (1 to 25-year return intervals), often combined with sporadic, small-scale, long or very-long return-interval crown fires and/or high-intensity surface fires (200 to 1000-year return intervals) (Mutch 1990) Typical fires are a few hundred acres (frequent, light surface fires) to a few thousand acres (crown fires with long or very long return-interval or high-intensity surface fires) in size The frequently occurring fires were generally of low intensity, because the short time span between fires left only small accumulations of dead and down fuels High-intensity stand-replacing fires were uncommon This regime of frequent, low-intensity fires promoted "open-grown" forests

As a result of fire suppression since the turn of the century, white fir density has greatly increased in mixed-conifer forests Today, unnatural, heavy accumulations of dead fuels and abundant, young white fir (which often form "dog-hair" thickets) greatly increase the chance for high-intensity, stand-replacing crown fires

Insects, Disease, and Other Natural Disturbances: Mature white fir trees are significantly affected by rift crack, wind throw, wood-rotting fungi, bark beetles, and spruce budworm (Fowells 1965) Douglas-fir dwarf mistletoe is the most significant disease of the Douglas-fir and the Douglas-fir beetle and the spruce budworm are the most significant insect pests (Fowells 1965)

Potential Production: The site index for potential timber productivity for the major soil types is 40 to 60 for Douglas-fir (base age 100 years). Range productivity for the major soil types based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year), ranges from 20 to 100 in an unfavorable year, from 30 to 150 in a normal year, and from 50 to 200 in a favorable year.

Nutrient Cycling: These ecological sites are generally nitrogen deficient. Organic matter generates nitrogen and other nutrients at slow release rates, because of cold soil temperatures. Decomposition processes are relatively slow for large woody materials, which may persist for 100 years Leaves and small branches decompose in about five years

STRUCTURE:

Structure Class: The majority of the acreage is in Structure Classes 3 and 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA	6%	5%	22%	8%	59%	100%

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: Pre-settlement fire frequency in mixed-conifer forests of the central and southern Rocky Mountains was from 7-22 years (Appendix A) This falls into Heinselman's Fire Regime 2 which is characterized by frequent, light surface fires (1 to 25-year return intervals), often combined with sporadic, small-scale, long or very-long return-interval crown fires and/or high-intensity surface fires (200 to 1000-year return intervals) (Mutch 1990) Typical fires are a few hundred acres (frequent, light surface fires) to a few thousand acres (crown fires with long or very long return-interval or high-intensity surface fires) in size The frequently occurring fires were generally of low intensity, because the short time span between fires left only small accumulations of dead and down fuels High-intensity stand-replacing fires were uncommon This regime of frequent, low-intensity fires promoted "open-grown" forests

As a result of fire suppression since the turn of the century, white fir density has greatly increased in mixed-conifer forests Today, unnatural, heavy accumulations of dead fuels and abundant, young white fir (which often form "dog-hair" thickets) greatly increase the chance for high-intensity, stand-replacing crown fires.

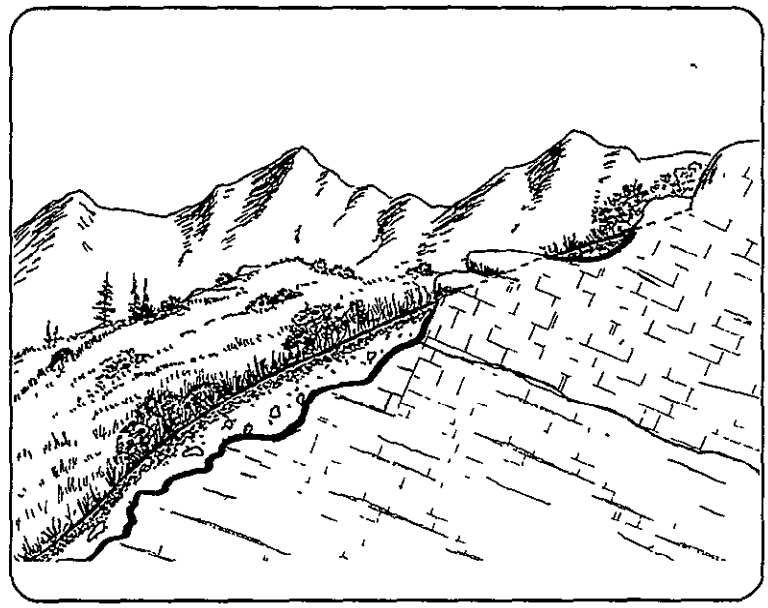
Insects, Disease, and Other Natural Disturbances: Mature white fir trees are significantly affected by rift crack, wind throw, wood-rotting fungi, bark beetles, and spruce budworm (Fowells 1965) Douglas-fir dwarf mistletoe is the most significant disease of the Douglas-fir and the Douglas-fir beetle and the spruce budworm are the most significant insect pests (Fowells 1965)

Potential Production: The site index for potential timber productivity for the major soil types is 40 to 60 for Douglas-fir (base age 100 years) Range productivity for the major soil types based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year), ranges from 20 to 100 in an unfavorable year, from 30 to 150 in a normal year, and from 50 to 200 in a favorable year

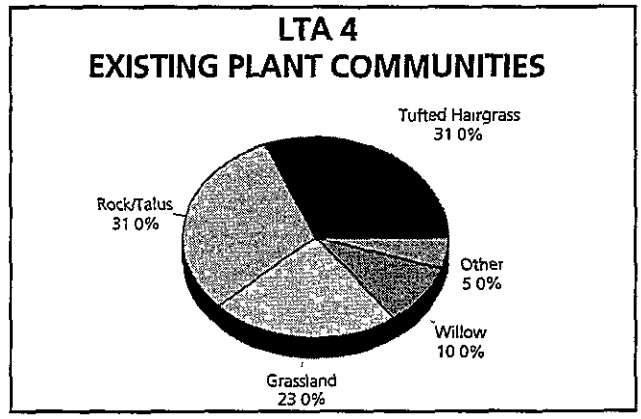
Nutrient Cycling: These ecological sites are generally nitrogen deficient Organic matter generates nitrogen and other nutrients at slow release rates, because of cold soil temperatures Decomposition processes are relatively slow for large woody materials, which may persist for 100 years Leaves and small branches decompose in about five years

LTA 4–Alpine Sedges and Forbs on Alpine Summits

SETTING: Sedges and forbs dominate this LTA, which occurs on gentle to very steep alpine summits at elevations of 11,000 to 14,000 feet The average annual precipitation is from 30 to 50 inches. Soils are generally shallow to very deep The LTA comprises about 250,000 acres (14%) of the Rio Grande Forest



LANDFORM, SLOPE, GEOLOGY AND SOILS: The LTA ranges from gentle to very steep alpine summits, with slopes ranging from 5 to 90 percent It includes high-elevation jagged peaks, glacial cirques, alpine ridges, glacial basins, and rock-outcrops Mirror soils comprise about 24% Rock Outcrop and Rubbleland comprise 19%, while Bross soils comprise 13% Mirror soils are moderately deep to bedrock, well drained, and are strongly acidic due to the high precipitation of this zone Bross soils are very deep, well to somewhat poorly drained, and also have strongly acid conditions. The erosion hazard is moderate to high. Mass-movement potential is low to high, but the high areas are usually rockfall and rockslides on steep slopes Other significant components include Cryumbrepts (12%), Teewinot (9%), and Cirque land (8%).



COMPOSITION:

Existing Habitat Dominants Plant communities range from early seral stages to sites at or near potential natural community.

Potential Natural Community: The following potential natural communities occur in this LTA

- willow/sedges
- kobresia/forbs
- elynoides sedge/golden avens
- planeleaf willow/cliff sedge

Thurber fescue/sedge
dwarf tufted phlox/bluegrasses
alpine fescue/bluegrass
elynoides sedge/bluegrasses-spike trisetum
kobresia/golden avens
sedge/alpinebistort
tufted hairgrass/sedges
golden avens/alpine fescue
kobresia/golden avens

Inclusions: rubble land, cirque land

Ecological Condition: Insufficient data available

STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: There is little information on fire frequencies in this ecological unit. It is likely that some fires from adjacent Engelmann spruce stands burned into this zone, but on a limited basis Fire frequencies for Engelmann spruce range from 63 years to 400 years (see LTA 1)

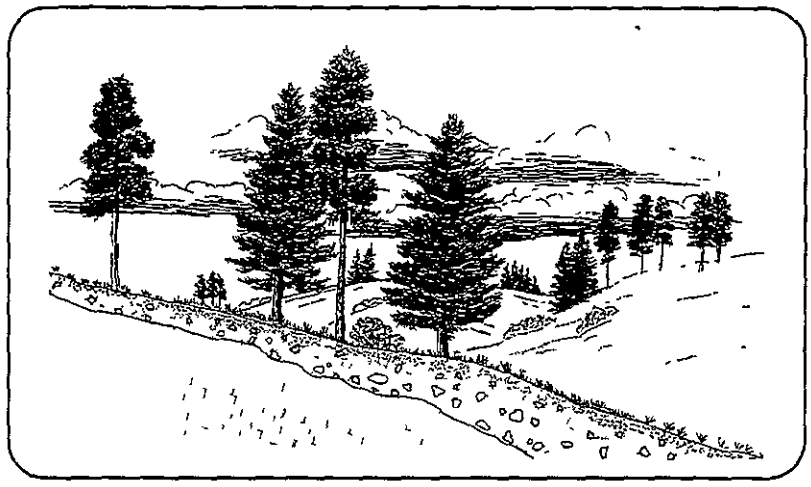
Insects, Disease, and Other Natural Disturbances:

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 500 to 1,200 in an unfavorable year, from 800 to 1,500 in a normal year, and from 1,000 to 2,000 in a favorable year Rock Outcrop and Rubbleland, which comprise 19% of this LTA, have only minimal potential productivity

Nutrient Cycling: These ecological sites are likely to be nutrient deficient, due to the strongly acidic soil conditions, which bind plant nutrients Soil leaching losses are also very high due to the high precipitation Organic matter is recycled in the soil matrix, whereby dead roots decompose fairly quickly, giving the soil its rich, dark, organic appearance These soils are difficult to reclaim due to the harsh growing conditions and soil limitations

LTA 5— Ponderosa Pine and Douglas-Fir on Mountain Slopes

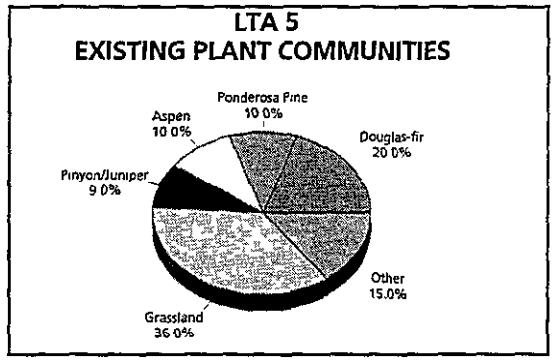
SETTING: Ponderosa pine and Douglas-fir dominate this LTA in a semi-forested grassland, which occurs on gentle to steep mountain slopes at elevations of 7,600 to 10,500 feet The average annual precipitation is from 12 to 25 inches. Soils are generally shallow to very deep The LTA comprises about 101,010 acres (6%) of the RGNF



LANDFORM, SLOPE, GEOLOGY AND SOILS: The LTA occurs on gentle to steep mountain slopes It includes some rock outcrops, steep glacial moraines, and alluvial fans The slopes range from 5 to 90 percent. Breccias are the dominant rock type in the San Juan mountains, while metamorphic and sedimentary rocks dominate the Sangre de Cristos Bushvalley soils comprise 23%, with Rock Outcrop comprising 22% The Cryoborolls comprise about 15% Bushvalley soil is shallow, well drained, and has considerable rock fragments. Cryoborolls are shallow to very deep and variable in rock fragment The erosion hazard is high Mass-movement potential is very low to moderate, with rockslides being the main form of movement

COMPOSITION:

Existing Habitat Dominants Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community



Potential Natural Community: The following potential natural communities occur in this LTA

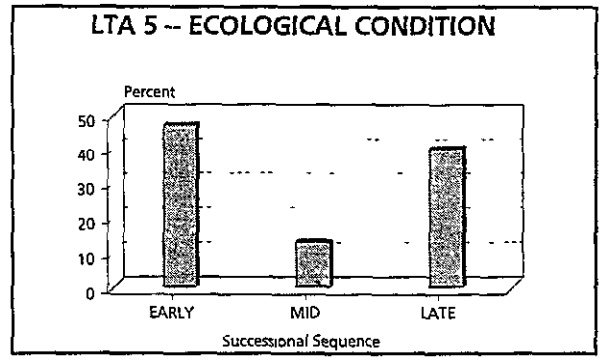
ponderosa pine/Gambel oak
ponderosa pine/Arizona fescue
ponderosa pine/Gambel oak-Arizona fescue
ponderosa pine-Douglas-fir/mountain muhly
ponderosa pine-Douglas fir/mountain muhly-Arizona fescue

Inclusions:

mountain muhly/Arizona fescue

pinyon/mountain muhly-Gambel oak
Douglas-fir/Arizona fescue
white fir-Douglas-fir/common juniper
pinyon/blue grama
white fir-Douglas fir/Arizona fescue
white fir-Douglas-fir/common juniper-kinnikinnick

Ecological Condition:



Early 47%

Mid· 13%

Late 40%

STRUCTURE:

Structure Class: The majority of the acreage is in Structure Classes 1 and 5.

Structure Class	1	2	3	4	5	Total
Percent of total LTA	39%	7%	7%	17%	25%	100%

Landscape Pattern: See Figure 3-18.

PROCESS:

Fire: In the Boise Basin of Idaho, mean fire intervals from 1700 to 1895 range from 9 8 years to 21 7 years for ponderosa pine-dominated Douglas-fir habitat (Steele et al 1986) On the San Juan NF in Colorado between 1750 and 1900, ponderosa pine/gambel oak had a fire interval of 3 9 years (Dieterich 1980a) Fire frequencies for dry ponderosa pine forests in New Mexico are 5 to 10 years (Kallander 1969), 5 to 12 years (Weaver 1951), and 1 8 to 2 4 years (Dieterich 1980a, 1980b)

In the Central Rockies, interpretation of fire-scar data from the Front Range of Colorado indicated that prior to 1840, ponderosa pine stands had a mean fire interval of 66 years (Laven et al 1980) Study sites exhibited a variable fire regime, small fires burned every 20 9 years and large fires every 41.7 years (Laven et al. 1980) However, intervening light ground fires may have occurred without scarring trees Hendrickson (1972) gave a fire-frequency estimate of 12 to 25 years for ponderosa pine in Colorado and Wyoming

Heinselman classifies this LTA as a Fire Regime 2 which is a frequent, light surface fire (1 to 25-year return intervals), often combined with sporadic, small-scale crown fires with long or very long return-interval and/or high-intensity surface fires (200-1,000 year return intervals) (Mutch 199)) Typical fires are a few hundred to a few thousand acres in size

Ponderosa pine is very resistant to fire Young Douglas-fir trees are vulnerable to surface fires due to their thin bark, resin blisters, flammable needles, and thin twigs and bud scales (Fischer and Clayton 1982) Mature Douglas-fir trees are only relatively resistant to fire

because of their closely spaced branches, gum cracks, and heavy fuel accumulations at the base of the tree (Bradley et al. 1992a)

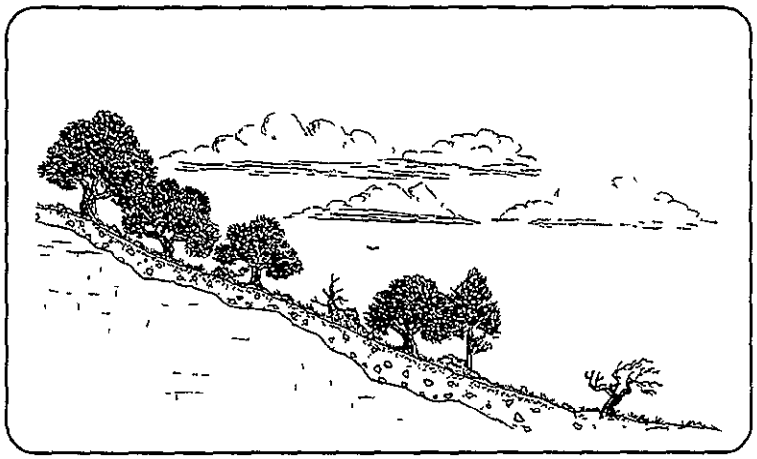
Insects, Disease, and Other Natural Disturbances: Western pine beetle and other beetles, western pine-shoot borer, wood-rotting fungi, dwarf mistletoe, blister rust, and needle blight cause severe damage of ponderosa pine (Fowells 1965, Stevens and Jennings 1977) Douglas-fir dwarf mistletoe is the most significant disease of the Douglas-fir, and the Douglas-fir beetle and the spruce budworm are the most significant insect pests (Fowells 1965).

Potential Production: The potential-timber-productivity site index for the major soil types is 25 to 35 for Douglas-fir (base age 100 years) These soils produce less than 20 cubic feet per acre per year. Douglas-fir and ponderosa pine are scattered throughout this LTA Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 500 to 600 in an unfavorable year, from 700 to 1,000 in a normal year, and from 900 to 1,200 in a favorable year Rock Outcrop, which comprises 22%, has only minimal potential productivity

Nutrient Cycling: These ecological sites are generally nitrogen deficient. Organic matter generates nitrogen and other nutrients at slow release rates because of cold temperatures and dry soil conditions. Decomposition processes are relatively slow for large woody materials, which may persist for 100 years Leaves and small branches decompose in about five years

LTA 6–Pinyon on Mountain Slopes

SETTING: Pinyon pine dominates this LTA, which occurs on gentle to very steep mountain slopes at elevations of 7,600 to 9,500 feet. The average annual precipitation is from 12 to 20 inches Soils are generally shallow to very deep The LTA comprises about 85,000 acres (5%) of the RGNF.

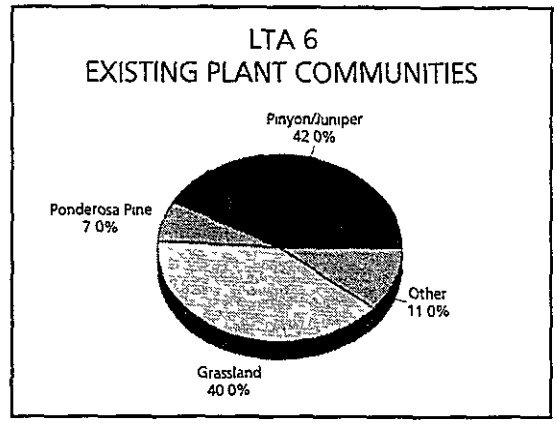


LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA ranges from gentle to very steep mountain slopes of 10 to 80 percent. Rock type is primarily breccias in the San Juan mountains, and metamorphic gneisses in the Sangre de Cristo Range Comodore soils comprise 25% of this LTA Bendire soils comprise 18% and Tolman soils comprise 15% Comodore and Tolman soils are shallow, well drained, and have considerable rock fragments Bendire soil is similar, but is moderately deep The erosion

hazard is moderate to high Mass-movement potential is very low to low Other soils include Rock Outcrop (13%), Curecanti (11%), and Alamaditas (3%)

COMPOSITION:

Existing Habitat Dominants Plant communities range from early seral stages, such as grass and forbs to sites at or near potential natural community



Potential Natural Community: The following potential natural communities occur in this LTA

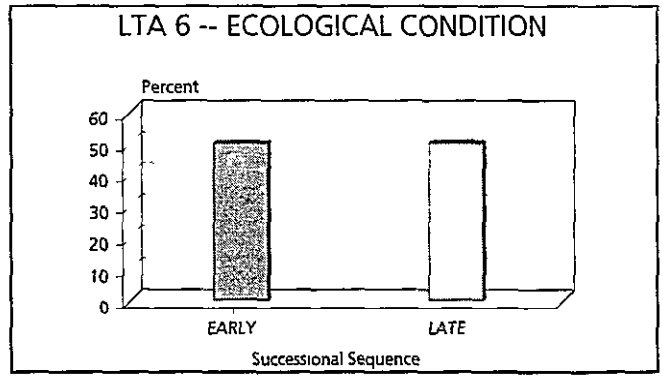
- pinyon/Gambel oak
- pinyon/blue grama
- pinyon/indian ricegrass
- pinyon/mountain muhly
- pinyon/mountain mahogony
- pinyon/Green needlegrass
- pinyon/mountain muhly-blue grama

Inclusions:

- ocean-spray/currant
- snakeweed/blue grama
- blue grama/fringed sage
- blue grama/fourwing saltbush
- ponderosa pine/Arizona fescue
- white fir-Douglas-fir/common juniper

Ecological Condition:

Early. 50%
Late· 50%



STRUCTURE:

Structure Class: The majority of the acreage is in Structure Classes 1, 2, and 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA·	42%	19%	1%	6%	28%	100%

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: Historical fire frequencies are 10 to 30 years in Arizona (Leopold 1924), 8 to 23 years for the Owyhee Plateau in Idaho (Burkhardt and Tisdale 1976), and 50 years in the Chisos Mountains of Texas (Moir 1982). Heinselman classifies Pinyon as a Fire Regime 1, which is characterized by infrequent, light surface fires (more than 25-year return interval), most fires are small (Mutch 1990). Pinyon pine trees under four feet tall are easily killed by fire These trees do not self-prune, so dead branches may form a fuel ladder into the crown (Crane 1982) "Pinyon-juniper stands most likely to burn by wildfire have small, scattered trees with abundant herbaceous fuel between the trees, or have dense, mature trees capable of carrying crown fire during dry, windy conditions" (Bradley et al 1992). Following fire, pinyons are absent from early successional stages. Seedlings establish primarily via the post-burn food caches of birds and rodents; successful establishment requires a nurse plant.

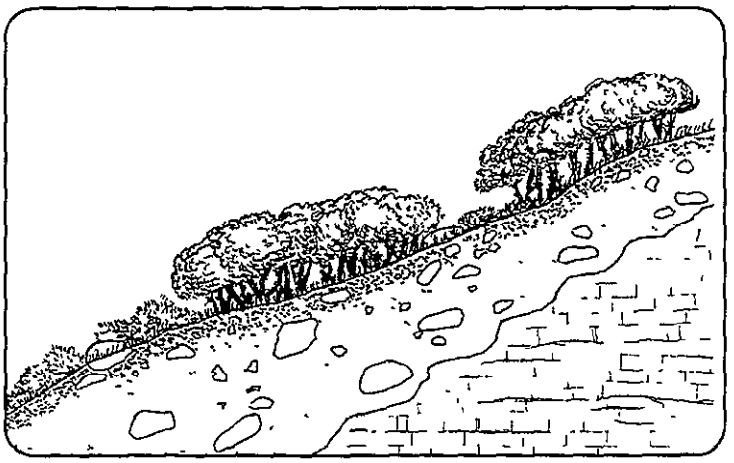
Insects, Disease, and Other Natural Disturbances: Bark beetles, scale insects, caterpillars of pine-cone moths, and pinyon-cone beetles are the primary insect pests (Fowells 1965) Fungi-caused diseases are pinyon blister rust, needle casts, butt and heartwood rot, root rot, and seedling blight (Fowells 1965)

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 400 to 500 in an unfavorable year, from 600 to 800 in a normal year, and from 800 to 1,100 in a favorable year.

Nutrient Cycling: Organic matter generates nitrogen and other nutrients at slow release rates because of cold soil temperatures. Decomposition processes are relatively slow for large woody materials, which may persist for 50 years Leaves and small branches decompose in about 5 years. The grasses decompose fairly quickly and contribute organic matter to the soil surface, giving it a dark color Hot burns can kill soil microflora and sterilize the site for at least seven years Cool burns release nutrients and result in vigorous growth in grasses

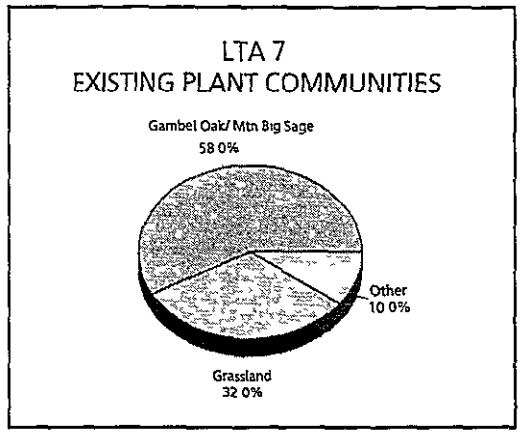
LTA 7– Gambel Oak on Mountain Slopes

SETTING: Gambel oak dominates this LTA, which occurs on moderate to very steep mountain slopes at elevations of 8,500 to 10,000 feet. The average annual precipitation is from 16 to 20 inches Soils are generally moderately deep to very deep. The LTA comprises about 2,600 acres (<1%) of the Rio Grande Forest



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA has very bouldery, moderate to very steep mountain slopes that range from 2 to 70 percent. Geology is variable and includes glacial deposits, metamorphic rocks, and alluvial fans Bowen family soils dominate this unit, comprising about 64% They are moderately deep to very deep and well drained, and have considerable rock fragments Curecanti soils (22%) are very deep and well drained, with considerable stones and rock fragments Gelkie soils (8%) are very deep and well drained, and loamy. The erosion hazard is low to high Mass-movement potential is low

COMPOSITION:



Existing Habitat Dominants Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community.

Potential Natural Community: The following potential natural communities occur in this LTA

Gambel oak/mountain muhly
Gambel oak/Arizona fescue
Gambel oak/mountain mahogany
Gambel oak-mountain big sagebrush

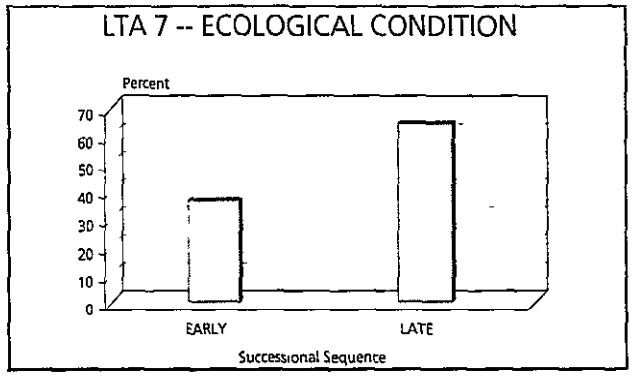
Inclusions:

Ponderosa pine/Arizona fescue
big sagebrush/Arizona fescue
Parry oatgrass/Arizona fescue
sagebrush/needle-and-thread

Ecological Condition:

Early: 36%

Late 64%



STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: Heinselman classifies Gambel oak as Fire Regime 1, which is characterized by infrequent, light surface fires (more than 25-year return intervals) (Mutch 1990) Wright (1990) speculates that fire frequency in the oak-brush zone is 50 to 100 years Spotty and irregular fires occur during dry years, after a buildup of litter and mulch under the shrub mottes (Wright 1990). It is likely that only extremely severe fires with maximum fuel

consumption would produce enough heat to kill the buried rhizomes Fire generally stimulates sprouting, which results in thicker stands (Brown 1958)

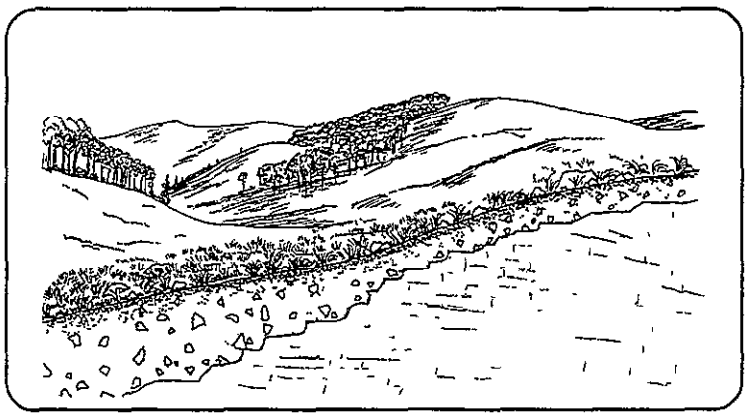
Insects, Disease, and Other Natural Disturbances: No information available.

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 800 to 1,300 in an unfavorable year, from 900 to 1,500 in a normal year, and from 1,100 to 1,900 in a favorable year.

Nutrient Cycling: Oak wood is fairly resistant to decomposition and may persist for 50 years Oak leaves recycle fairly quickly adding important nutrients back to the soil. Fire has likely burned on these sites at short intervals, periodically killing the oak, which quickly resprouts

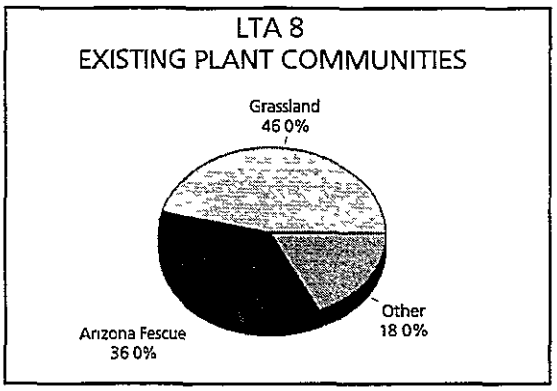
LTA 8–Arizona Fescue on Mountain Slopes

SETTING: This LTA consists of Arizona fescue and occurs on gentle to very steep mountain slopes at elevations of 8,400 to 10,800 feet The average annual precipitation is from 14 to 25 inches Soils are generally shallow to very deep The LTA comprises about 95,000 acres (5%) of the Rio Grande Forest



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA ranges from gentle to very steep mountain slopes and ridges. Slopes range from 5 to 70 percent Geology consists of volcanic breccias Embargo soils comprise 14% of this unit Quander soils comprise 13% and Tellura soils comprise 10% These soils are moderately deep to very deep, and have clayey subsoils with considerable rock fragments The erosion hazard is moderate Mass-movement potential is very low to low Other soils include Bowen (6%), Cabin (6%), Bachelor (5%), Bushvalley (5%), Rogert (5%), Condie (5%), Lymanson (3%), Youga (3%), Gateview (3%), Winnemucca (2%), Winz (2%), and Haploborolls (2%)

COMPOSITION:



Existing Habitat Dominants Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community

Potential Natural Community: The following potential natural communities occur in this LTA:

Arizona fescue/mountain muhly
Arizona fescue/Thurber fescue
Arizona fescue/Parry oatgrass
Arizona fescue/Parry oatgrass-Thurber fescue
ponderosa pine/Arizona fescue-mountain muhly

Inclusions:

pinyon/oceanspray-mountain muhly
mountain-mahogany/gooseberry currant
needle-and-thread/blue grama
blue grama/fringed sage
Baltic rush/sedge
mountain muhly/rabbitbrush
Engelmann spruce-subalpine fir/Rocky Mountain whortleberry

Ecological Condition: Insufficient data available

STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: There is little information on fire frequencies in this ecological unit It is likely that some fires from adjacent ponderosa pine/Douglas-fir habitat burned into this zone Fire frequencies for ponderosa pine/Douglas-fir range from 2 to 46 years (See LTA 5)

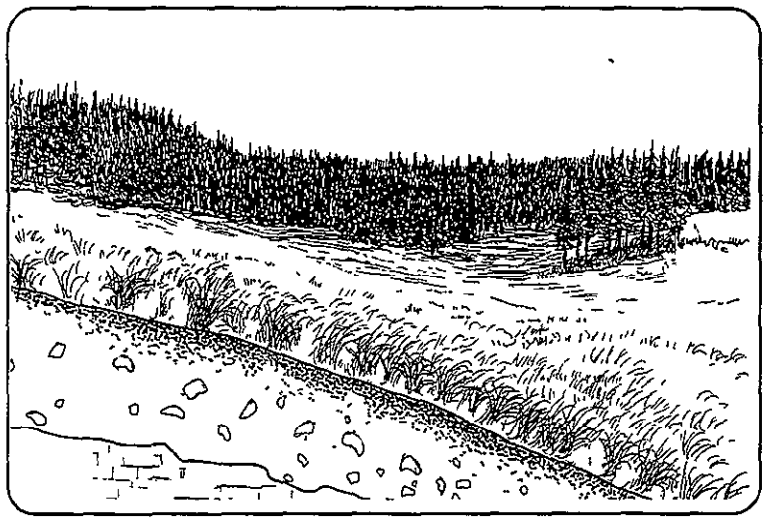
Insects, Disease, and Other Natural Disturbances: No information available

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs in air-dry pounds per acre per year ranges from 700 to 1,200 in an unfavorable year, from 1,400 to 1,500 in a normal year and 1,800 in a favorable year

Nutrient Cycling: Grasslands generally recycle nutrients fairly rapidly Roots grow, expand, and then die and add organic materials to the soil surface This results in a rich, dark, organic surface soil with good aeration and infiltration. Burns likely occur periodically, but are cool enough so that nutrients are made available for plant uptake More vigorous, nutrient-rich grasses result.

LTA 9–Thurber Fescue on Mountain Slopes

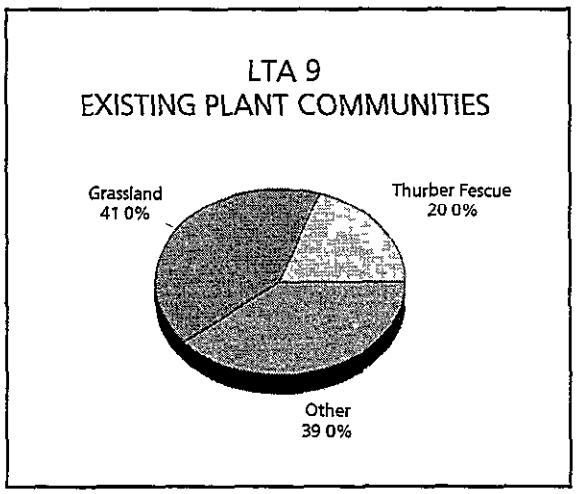
SETTING: Thurber fescue dominates this LTA, which occurs on gentle to very steep mountain slopes at elevations of 8,400 to 10,800 feet The average annual precipitation is from 18 to 45 inches. Soils are generally shallow to deep The LTA comprises about 102,000 acres (6%) of the Rio Grande Forest



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA ranges from gentle to very steep mountain slopes, toeslopes, ridges, and fans. The slopes range from 2 to 70 percent. Geology consists of volcanic rocks such as breccias, rhyolites, and andesites. Quander soils comprise about 32% of this LTA Tellura soils comprise 18% and Gothic soils 13% They are very deep soils having clayey subsoils The erosion hazard is mostly moderate, with a small amount of high hazard in the Chama Basin Mass-movement potential is mostly very low to low, with some high Mass-movement potential in the Chama Basin Other soils include Bowen (11%), Bushvalley (8%), Booneville (2%), and Clayburn (2%)

COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community



Potential Natural Community: The following potential natural communities occur in this LTA.

False hellbore/Thurber fescue
Thurber fescue/Arizona fescue
Arizona fescue/Thurber fescue

Inclusions
Parry oat grass/Arizona fescue
rush/sedge-bluegrass
Arizona fescue/mountain muhly

Ecological Condition: Insufficient data available

STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: There is little data on fire frequencies in this ecological unit It is likely that some fires from adjacent Engelmann spruce/subalpine fir or aspen habitat burned into this zone Fire frequencies for Engelmann spruce/subalpine fir range from 63 years to 400 years (see LTA 1) and fire frequencies for aspen range from 6 years to 150 years (see LTA 2) Johnston and Hendzel reported increased densities of Thurber fescue four years after a spring time prescribed burn on a late-seral aspen/Thurber fescue site in Colorado. Recovery of Thurber fescue may be poor where accumulated litter results in severe soil heating (Bradley et al. 1992b) Thurber fescue can regenerate through the surviving root crown or from wind-dispersed seed (Bradley et al 1992b)

Insects, Disease, and Other Natural Disturbances: No information available

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 1,200 to 2,000 in an unfavorable year, from 1,500 to 2,500 in a normal year, and from 1,800 to 3,000 in a favorable year The higher producing sites are in the Chama Basin, where precipitation is generally higher than over most of the Forest

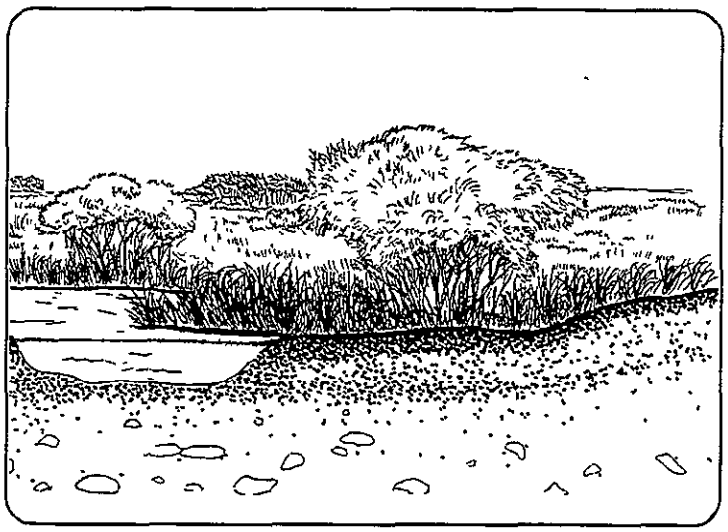
Nutrient Cycling: Grasslands generally recycle nutrients fairly rapidly Roots grow, expand and then die and add organic materials to the soil surface This results in a rich, dark, organic surface soil with good aeration and infiltration Burns likely occur periodically, but are cool enough so that nutrients are made available for plant uptake. More vigorous, nutrient-rich grasses result

LTA 10–Willows and Sedges on Floodplains

SETTING: Willows and sedges dominate this LTA, which occurs on gentle slopes at elevations of 8,600 to 11,600 feet The average annual precipitation ranges from 17 to 35 inches Soils are very deep The LTA comprises about 54,000 acres (3%) of the Rio Grande Forest

LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA may be found on gently sloping floodplains, low terraces, toeslopes, fans, mountain valleys, and glacial moraines Slopes range between 0 and 30 percent Geology is mixed alluvium or glacial till from volcanic or sedimentary sources Cryaquolls comprise about 46% of the soils in this unit and are very deep, poorly and very poorly drained, and variable in texture. Cryoborolls comprise 19% and are variable in depth, well drained to moderately well drained, and variable in texture

Cryohemists (14%) are organic soils consisting of peats and are poorly or very poorly drained High water tables in the Cryaquolls and Cryohemists affect many potential uses The erosion hazard is low to moderate Mass-movement potential is very low to moderate Other soils include Quander, comprising 4%, and Aquic Cryofluvents, 1%.



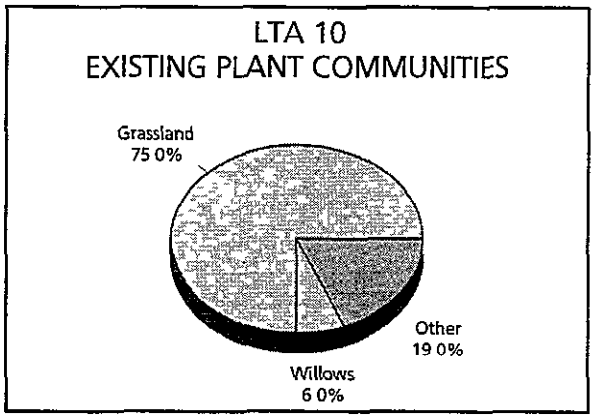
COMPOSITION:

Existing Habitat Dominants
Plant communities range from early seral stages, to sites at or near potential natural community

Potential Natural Community: The following potential natural communities occur in this LTA·

tufted hairgrass/sedge
willow/sedge
sedge/elephant-head

Inclusions.
Thurber fescue/Arizona fescue



Ecological Condition: Insufficient data available

STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18.

PROCESS:

Fire: Fire is relatively infrequent in deciduous riparian communities due to moist conditions and rapid decomposition of leaf litter (Bradley et al 1992b) Bebb willow is characterized as Heinselman's Fire Regime 3, which is characterized by infrequent, severe (often high-intensity) surface fires (more than 25-year return intervals), usually in combination with long return-interval (100 to 300 years) sporadic crown fires and/or higher-intensity surface fires that kill most, but not all stand elements High-intensity fires can destroy trees and top-kill shrubs, but recovery is rapid (Bradley et al 1992b)

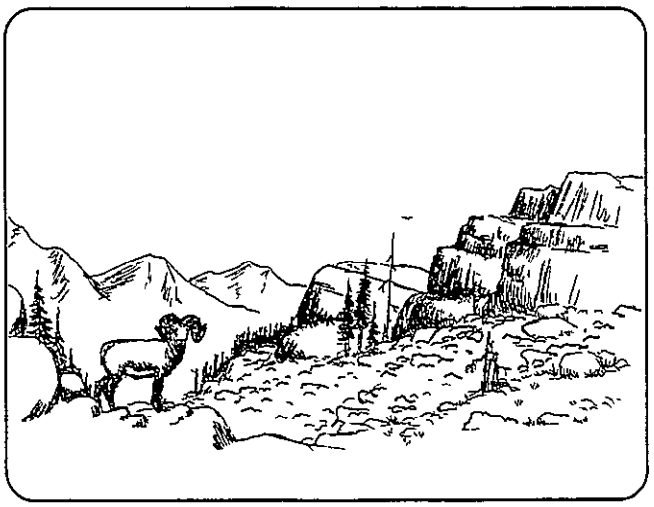
Insects, Disease, and Other Natural Disturbances: Caterpillars and other insects rarely kill willows (Newsholme 1992) Rust and fungal die-back can be a problem (Newsholme 1992)

Potential Production: These sites are some of the most important and potentially productive ecosystems on the Forest Range productivity for the Cryaquolls and Cryohemists, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) range from 2,000 in an unfavorable year, to 3,000 in a normal year, and 4,000 in a favorable year Range productivity for the Cryoborolls, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) range from 1,200 in an unfavorable year, to 1,800 in a normal year, and 2,500 in a favorable year

Nutrient Cycling: Grasslands generally recycle nutrients fairly rapidly Roots grow, expand, and then die, and add organic materials to the soil surface This results in a rich, dark, organic surface soil with good aeration and infiltration Burns likely occur periodically, but are cool enough so that nutrients are made available for plant uptake More vigorous, nutrient-rich grasses result

LTA 11–Nonvegetated Areas on Mountain Slopes

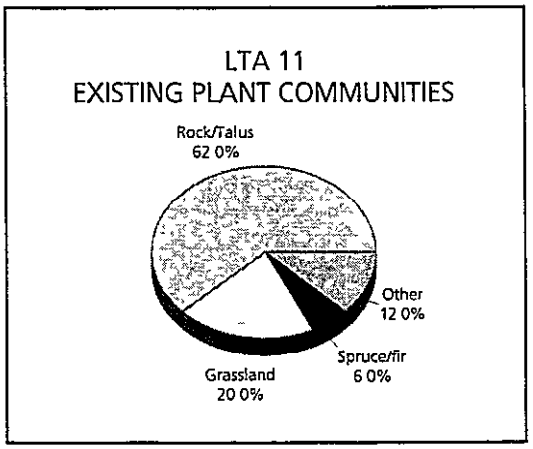
SETTING: Rock outcrop and rubble land dominate this LTA, which occurs on gentle to near-vertical cliffs, at elevations of 8,400 to 14,000 feet The average annual precipitation is from 12 to about 30 inches The LTA comprises about 46,000 acres (3%) of the RGNF



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA is a miscellaneous landtype that consists of rock outcrop, rubble land, volcanic dikes, cliffs, mine dumps, and dune land Slopes range from 2% to nearly vertical cliffs Volcanic, sedimentary, and metamorphic rocks comprise this unit The unit consists primarily of rock outcrops, with inclusions of other miscellaneous landtypes

COMPOSITION:

Existing Habitat Dominants: Although most of this LTA is rock outcrop and rubble land, there are sparse covers of vegetation within the rocky areas Plant communities range from early seral stages to sites having tree cover



Potential Natural Community: These areas are basically rocky areas with small inclusions of vegetation

Ecological Condition: Not applicable for this LTA

STRUCTURE:

Structure Class: Not applicable for this LTA

Landscape Pattern: See Figure 3-18.

PROCESS:

Fire: Fire is relatively infrequent in deciduous riparian communities due to moist conditions and rapid decomposition of leaf litter (Bradley et al. 1992b). Bebb willow is characterized as Heinselman's Fire Regime 3, which is characterized by infrequent, severe (often high-intensity) surface fires (more than 25-year return intervals), usually in combination with long return-interval (100- to 300-years) sporadic crown fires and/or higher-intensity surface fires that kill most, but not all stand elements. High-intensity fires can destroy trees and top-kill shrubs, but recovery is rapid (Bradley et al 1992b).

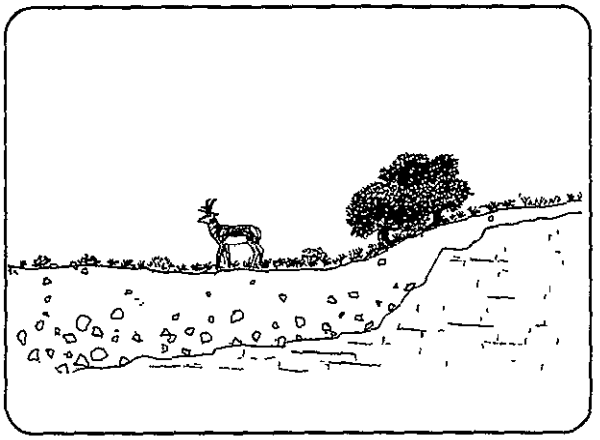
Insects, Disease, and Other Natural Disturbances: Not applicable for this LTA

Potential Production: Potential productivity is very low.

Nutrient Cycling: Not applicable to this LTA

LTA 12–Western Wheatgrass and other Low-Elevation Grasslands on Alluvial Fans

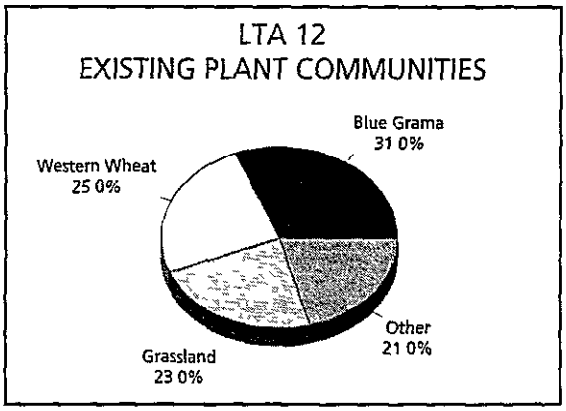
SETTING: Western wheatgrass dominates this LTA , which occurs on gentle to moderate alluvial fans at elevations of 8,000 to 9,300 feet. The average annual precipitation is from 12 to 18 inches Soils are generally very deep The LTA comprises about 25,000 acres (1%) of the RGNF



LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA ranges from gentle to moderate alluvial fans, toeslopes, colluvial slopes, benches, ridgetops, and dune lands Slopes range from 0 to 40 percent Alluvium deposits have mixed geology Guben soils comprise about 23%, with Curecanti soils 17% and Jodero soils 15%. These soils are very deep, well-drained, and have calcareous substrates. The erosion hazard is low to moderate Mass-movement potential is very low. Other soils include Empedrado (13%), Luhon (9%), and Delson (7%)

COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages to sites at or near potential natural community



Potential Natural Community: The following potential natural communities occur in this LTA

western wheatgrass/needle-and-thread
western wheatgrass/blue grama

Inclusions:

needle-and-thread/Indian ricegrass
needle-and-thread/nodding brome
ponderosa pine/Arizona fescue
Gambel oak/mountain muhly
blue grama/fringed sage
pinyon pine/blue grama
blue grama/winterfat

Ecological Condition: Insufficient data available

STRUCTURE:

Structure Class: No applicable data available for nonforested LTAs

Landscape Pattern: See Figure 3-18

PROCESS:

Fire: The fire regime for Western wheatgrass is characterized by frequent, light surface fires with 1- to 25-year return intervals Fire frequency for level-to-rolling grassland is estimated at 5 to 10 years, while the fire frequency for more dissected topography is estimated at 20 to 30 years (Wright and Bailey 1980) It is likely that fires from adjacent ponderosa pine/Douglas-fir habitat and pinyon pine habitat burned into this zone Fire frequencies for ponderosa pine/Douglas-fir range from 2 to 46 years (See LTA 5) Fire frequencies for pinyon pine range from 8 to 50 years (See LTA 6)

After a fire Western wheatgrass increases in abundance and density through surviving rhizomes (Bradley et al. 1992a) Fire probably stimulates the rhizomes to initiate new shoots at primordial regions of the root system The growth habit of wheatgrass discourages adverse surface heating (Bradley et al 1992a) During a fire the culms (stems) usually burn rapidly, with little heat transferred downward into meristematic tissue Coupland (1973) found a 19-percent reduced production in western and thickspike wheatgrass one year after an August wildfire in southwestern Saskatchewan Launchbaugh (1964) found that western wheatgrass had fully recovered three years after a fire

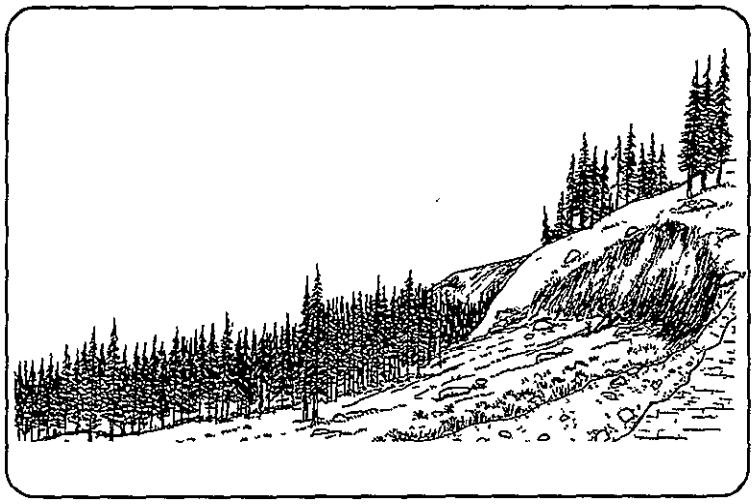
Insects, Disease, and Other Natural Disturbances: No information available.

Potential Production: Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 350 to 1,000 in an unfavorable year, from 600 to 1,500 in a normal year, and from 800 to 1,800 in a favorable year.

Nutrient Cycling: Grasslands generally recycle nutrients fairly rapidly Roots grow, expand and then die and add organic materials to the soil surface This results in a rich, dark, organic surface soil with good aeration and infiltration. Burns likely occur periodically, but are cool enough so that nutrients are made available for plant uptake More vigorous, nutrient rich grasses result

LTA 13–Engelmann Spruce on Landslides

SETTING: Engelmann spruce dominates this LTA, which occurs on gentle to steep landslide deposits at elevations of 8,800 to 11,800 feet The average annual precipitation is from 20 to 45 inches Soils are generally very deep The LTA comprises about 37,000 acres (2%) of the Rio Grande Forest

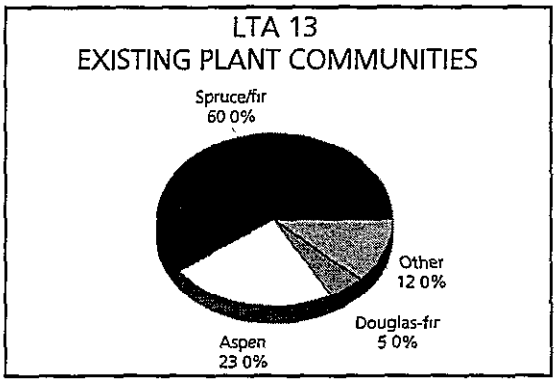


LANDFORM, SLOPE, GEOLOGY, AND SOILS: The LTA ranges from gentle to steep landslide deposits of 2- to 60-% slopes. It consists of block slump slopes, earthflows, old landslides, fan deposits, and unstable mountain slopes Granile soils comprise about 42% with Leighcan 26% These soils are very deep and well drained The erosion hazard is moderate Mass-movement potential is moderate to high Other soils include Aquic Cryoboralfs (3%), Aeric Cryaquepts (3%), Cochetopa (2%), and Harkness (1%).

COMPOSITION:

Existing Habitat Dominants: Plant communities range from early seral stages, such as grass and forbs, to sites at or near potential natural community

Potential Natural Community: The following potential natural communities occur in this LTA



subalpine fir-Engelmann spruce/Rocky Mountain whortleberry

Inclusions:

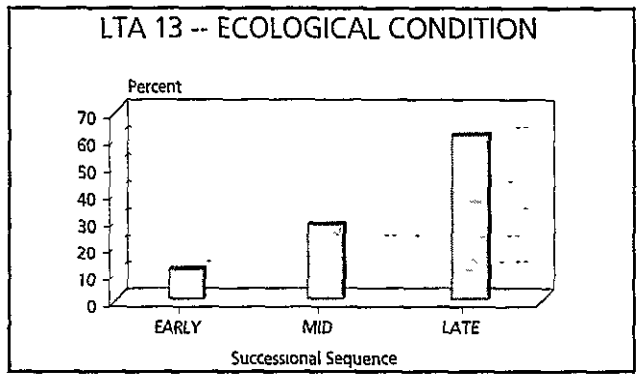
white fir-Douglas-fir/fleabane
white fir-Douglas-fir/kinnikinnick-common juniper

Ecological Condition:

Early: 11%

Mid. 28%

Late: 61%



STRUCTURE:

Structure Class: The majority of the acreage is in Structure Class 5

Structure Class	1	2	3	4	5	Total
Percent of total LTA	12%	1%	11%	5%	69%	100%

Landscape Pattern: See Figure 3-18.

PROCESS:

Fire: Engelmann spruce has variable fire frequencies Various studies have shown fire frequencies ranging from 63 to 400 years in interval (Arno 1980, Romme 1979, Scott 1981, Alexander 1987) Engelmann spruce has thin bark and dead lower-limb persistence that makes it susceptible to fires and easily killed even by low-intensity fires. Post-fire reestablishment is via wind-dispersed seeds which readily germinate on fire-prepared seedbeds Many Engelmann spruce stands are even-aged, suggesting that they developed after fire. Subalpine fir is extremely susceptible to ground and crown fires, because it has thin bark and is resinous, and the narrow crown usually extends to the ground (Fowells 1965)

Insects, Disease, and Other Natural Disturbances Spruce beetle is the most serious insect pest of mature and over-mature Engelmann spruce Six large-scale outbreaks of spruce beetle have occurred in the southern Rocky Mountains since the mid-1800s (Baker and Veblen 1990) The western spruce budworm, a defoliator, also causes considerable damage to Engelmann spruce and subalpine fir (Lynch and Swetnam 1992) Return intervals for the western spruce budworm in Colorado and New Mexico are approximately 30 to 40 years (Swetnam and Lynch 1989) Other significant insect pests of the subalpine fir are the black-headed budworm and the western balsam bark beetle (Fowells 1965) Wood-rotting fungi are the most common diseases in Engelmann spruce and subalpine fir (Fowells 1965)

Potential Production: These soils have some of the highest timber production on the Forest, but have high mass-movement potential, making them subject to mass failure. The

potential timber productivity site index for the major soil types is 55 to 95 for Engelmann spruce (base age 100 years) Range productivity for the major soil types, based on grasses, forbs, and annual twig growth of shrubs (in air-dry pounds per acre per year) ranges from 50 to 100 in an unfavorable year, from 75 to 150 in a normal year, and from 100 to 200 in a favorable year

Nutrient Cycling: These ecological sites are generally nitrogen deficient. Organic matter generates nitrogen and other nutrients at slow release rates because of cold soil temperatures. Decomposition processes are relatively slow for large woody materials, which may persist for 100 years. Leaves and small branches decompose in about 5 years

Cover Types

This section focuses on forested cover types (the existing vegetation) on the RGNF because the data available for the rangelands is too general in the areas of age or structural stage. The discussion in the previous section on LTAs has some information on rangeland cover types, especially LTAs 4, 8, 9, 10, and 12 In addition, the Forest does have data concerning rangeland conditions (see the Range Section) This data has been used to assess carrying capacity and restoration needs for the rangeland resource

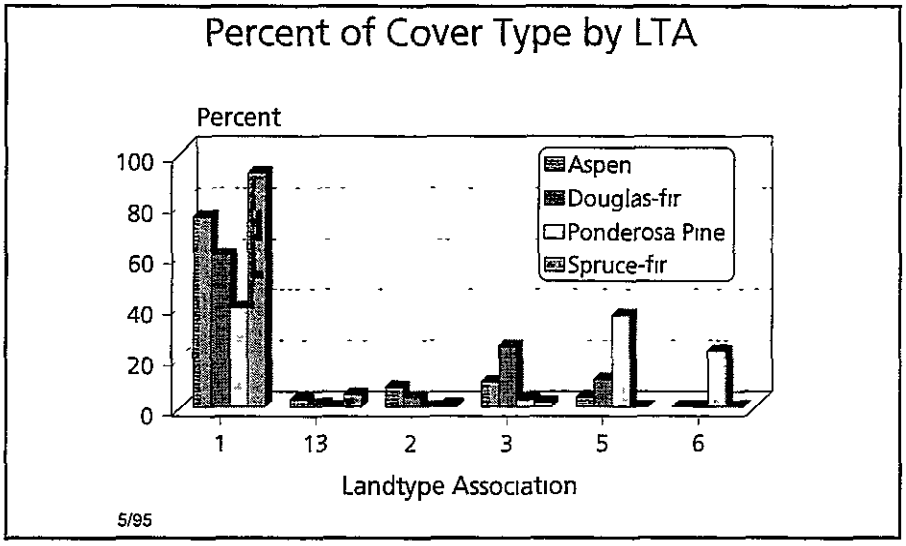


Figure 3-19. Percent of Cover Type by LTA

There is no attempt to try to determine if that vegetative pattern will change due to successional changes That discussion was covered previously in the LTA section.
There are two primary reasons for talking about cover types and LTAs separately First, with respect to patterns of vegetation, cover types more accurately depict the situation as it exists now and into the near future (less than 50 years) Second, because cover types can occur in several LTAs, it is difficult to capture the vegetative patterns by looking only at the LTAs (See Figure 3-18)

The value of the cover type for a myriad of resources (e g , wildlife, plants, and timber) varies with the age of the forest stands within the cover type Some age-class data have been collected on about one-third of the RGNF Because of the large amounts of uneven-aged forest stands on the RGNF, it is hard to use the data to generate precise ages for the

various stands The data can be used, however, to make some generalizations about the relative ages of the cover types

Table 3-16 shows how the age of most cover types compares with the life expectancy of that cover type This is a way to determine the relative age of the particular cover types. For example, given the age of the majority of the aspen, a generalization could be made that the RGNF's aspen tends to be older, given its life expectancy

Table 3-16. Comparative Age of RGNF Cover Types

COVER TYPE	AGE OF MOST RGNF STANDS	LIFE EXPECTANCY
Aspen	65-125	150
Douglas-fir	95-155	300
Lodgepole Pine	95-155	250
Ponderosa Pine	95-155	300
Spruce/fir	125-215	200-250 (subalpine fir) 300-400 (spruce)

Since age-class data was available on only a limited number of RGNF timber stands another method for approximating age class had to be used That method was grouping the various timber stands by structural class Structural classes were used because of the assumption that a forest stand ages as it moves through the sequential size stages in growth (See Table 3-17)

Table 3-17. Percent of Structure Class by Cover Type

STRUCTURE CLASS	COVER TYPE				
	Aspen	*Ponderosa Pine*	*Douglas-fir*	*Spruce-fir*	*Lodgepole Pine*
1	10	1	1	3	9
2	9	2	5	3	7
3	42	<1	12	6	51
4	3	34	20	13	8
5	36	64	62	75	25
	100%	100%	100%	100%	100%

Detailed descriptions of the four main cover types on the RGNF follow

Engelmann Spruce/Subalpine Fir

The Engelmann spruce/subalpine fir cover type occupies roughly 561,000 acres, or 31% of the total Forest area About 88% is in the mature to late-successional structural classes

Spruce/fir stands are found from 8,600 to 12,000 feet in elevation They are the dominant forest cover type on the RGNF Engelmann spruce is rated tolerant, and subalpine fir very tolerant, in the ability to endure shade and competition from surrounding trees

Engelmann spruce is longer-lived than subalpine fir Dominant Engelmann spruce are often 250 to 450 years old, subalpine fir older than 250 years old are not uncommon, but the species is so adversely affected by heartrot that many trees die or are completely rotten at an early age (Alexander 1987). Consequently, most of the mature- to late-successional spruce/fir stands on the RGNF are dominated by Engelmann spruce in the overstory (usually 70-90% of the basal area), while subalpine fir may appear to dominate the understory with spruce Both species can be found in nearly pure stands, with spruce often forming such stands at the upper elevations (11,000-12,000'). Other species associated with Engelmann spruce/subalpine fir stands are aspen and lodgepole pine

Spruce/fir stands on the Forest can be single-storied, two- or three-storied, or multi-storied, indicating that spruce/fir can be grown under both even- and uneven-aged management The variability of such stand conditions is due to disturbances such as fire, insect epidemics, and harvesting, or to the gradual disintegration of overmature stands from wind, insects, and disease Engelmann spruce has a shallow root system and is susceptible to windthrow

Windthrow susceptibility is especially high where water tables or soils are shallow or where recent disturbances have created spaces in the forest canopy that allow previously protected trees to be exposed to wind (e g , openings created by harvest cuttings) Areas of windthrown spruce can become starting points for spruce beetle infestations, which can lead to widespread epidemics Such an epidemic occurred near Crystal Lakes on the Divide (formerly Del Norte) Ranger District in the late 1970s. (The origin of the outbreak was traced to an area of windthrown timber.) Following widespread epidemics, large numbers of standing- and/or downed-dead trees can greatly increase fuel loadings and increase the risk of high intensity, stand-replacement fires (For more information on spruce/fir forests and disturbances, refer to the "Fire and Fuels Management" and Insects and Disease" sections in this chapter.)

Douglas-Fir (Mixed-conifer)

The Douglas-fir cover type occupies some 199,000 acres, or about 11% of the total Forest acreage. About 83% is in the mature to late-successional structural classes

The Douglas-fir cover type is often referred to as the "mixed-conifer" cover type, due to the great diversity of conifer species that are associated with Douglas-fir Those associate species on the RGNF are white fir, ponderosa pine, Engelmann spruce, lodgepole pine, subalpine/corkbark fir, blue spruce, bristlecone pine, limber/southwestern white pine, and pinyon pine Additionally, aspen is often found in varying densities in mixed-conifer stands Diverse combinations of the above species can be found, with nearly pure stands of Douglas-fir grading to stands containing mixes of six species or more. On the RGNF, white fir is the prime associate with Douglas-fir south of the Del Norte/South Fork area. North of this area, white fir occurs with much less frequency

The composition of Douglas-fir stands depends on elevation, aspect, and disturbance history The varying sensitivity to fire disturbance has greatly influenced stands on the RGNF Most of the previously mentioned species are sensitive to fire in the seedling/sapling stages—but upon reaching maturity, both ponderosa pine and Douglas-fir produce thick, fire-resistant bark Thin-barked species like white fir, blue/Engelmann spruce, and

subalpine/corkbark fir are readily injured or killed by fire (refer to the "Fire and Fuels Management" section for more information)

Douglas-fir-dominated stands are generally found on the RGNF from 7,600 to 11,000 feet in elevation It is rated intermediate relative in its tolerance of shade and root competition On drier sites, where Ponderosa pine is the dominant seral species, Douglas-fir becomes the late-seral or even climax species On moister sites, Douglas-fir is often the mid-seral species, with white fir, spruce, or subalpine fir becoming the climax species Both diameter and height growth become extremely slow or practically cease after age 200, though some trees have reached ages of 400 years (USDA 1990)

Since the advent of fire suppression, Douglas-fir stands on the RGNF have become increasingly dense as young stems of shade-tolerant species have invaded beneath the overstories of earlier successional species (see Appendix A–Range of Natural Variability Assessment) A result has been increasing impacts from the western spruce budworm which thrive in Douglas-fir-dominated stands that are densely stocked and multi-storied (refer to the "Fire and Fuels Management" and "Insects and Disease" sections for more information)

Lodgepole Pine

The lodgepole pine cover type occupies roughly 30,000 acres, or 1 7% of the Forest About 33% is in the mature to late-successional structural classes, 60% is in the pole class, with about 7% in the seedling class

Lodgepole pine is found in large pure stands and in association with other conifers and aspen Lodgepole pine is intolerant of shade and root competition, hence, it grows best in full sunlight in even-aged stands On the RGNF, this species is generally found between 9,000 and 11,500 feet in elevation Naturally existing stands of lodgepole pine are found only on the Saguache Ranger District of the RGNF—this is the southernmost reach of this species in the Rocky Mountains (excepting scattered pockets in the Sangre de Cristo Mountains east of San Luis) (USDA 1990) Here, lodgepole pine forms dominant seral stands that can exist for several hundred years in the absence of fire. Barring disturbance, Engelmann spruce and subalpine fir will generally invade beneath the pine On sites where poor soils limit the establishment of less adaptable species, lodgepole pine can form climax stands

Lodgepole pine is considered a fire-maintained subclimax species (USDA 1990) This species commonly produces "serotinous" cones Such cones do not normally open at maturity due to resinous bonds between cone scales These bonds break down when subjected to temperatures between 113 and 140 degrees (USDA 1990). The seeds within the closed cones can remain viable for many years—often until a fire burns through the stand, opening the cones, and dropping a copious amount of seed on a newly prepared seedbed With frequent fires, lodgepole pine can be self-perpetuating Serotinous cones within one foot of the soil surface will also open when summer solar radiation raises soil surface temperatures to levels sufficient to break down the resinous bonds Regeneration of clearcuts in serotinous stands is generally accomplished by knocking down cone-bearing branches to the ground, thereby taking advantage of soil surface heat to open the cones and release the seeds

Ponderosa Pine

The ponderosa pine cover type occupies roughly 38,000 acres, or 2 1% of total Forest acreage About 97% is in the mature or late-successional structural class

On the RGNF, ponderosa pine is typically found from 7,600 to 10,500 feet in elevation At the lower elevations, it can form near-climax stands, generally made up of small even-aged groups. At higher elevations, where moisture is not as limiting, ponderosa pine becomes a lesser component of the Douglas-fir/mixed-conifer type

Ponderosa pine is intolerant of shade and root competition, and is best managed in even-aged stands or groups. Though susceptible to fire in early stages, ponderosa pine can produce thick, fire-resistant bark as it matures. From historical documents and photos of the RGNF and adjoining forests, we know that ponderosa pine formed extensive stands prior to the 1900s, largely due to frequent fires, which favored this species over less fire-tolerant species. With the coming of European settlers to the RGNF, ponderosa pine was readily harvested for fuelwood, then sawlogs Additionally, fire suppression efforts initiated in the early 1900s allowed late seral/climax understories of Douglas-fir and white fir to develop Together, fire suppression and selective harvesting of ponderosa pine are suspected to have reduced the overall cover of ponderosa pine in mixed-conifer stands, since pre-settlement days

Aspen

The aspen cover type occupies some 261,000 acres, or 14 3% of the total Forest acreage About 39% is in the mature to late-successional structural classes, 51% in the pole class, and the remaining 10% in the seedling class

On the RGNF, aspen stands are typically found between 8,500 and 11,000 feet in elevation. At either elevational limit it is poorly developed, becoming stunted, twisted, or scrubby Aspen is very intolerant of shade and competition Generally, aspen is the initial pioneer tree species to invade burned areas, and in the absence of further disturbance will eventually be replaced by mid- to late-seral coniferous species such as Douglas-fir, white fir, Engelmann/blue spruce, and subalpine fir In rare instances, it can form a de facto climax forest where extensive fires have removed coniferous species These large aspen stands can become self-perpetuating where invading conifer seed is not available.

Aspen can propagate by seed, but on the RGNF reproduction is largely by clonal suckering (root sprouts). A clone is formed by the vegetative reproduction of stems from sprouts originating from a single-parent root system Stems arising from the same parent exhibit similar characteristics of form and structure. Conversely, neighboring clones can be distinguished by differing leaf shape and size, bark character, branching habit, stem form, suckering ability, time of flushing, and autumn leaf color and timing of color change (USDA 1990)

Disturbance of aspen clones, such as by fire or cutting, stimulates suckering, with the greatest number of suckers produced when the overstory is completely removed Full removal of an aspen or conifer overstory is essential for growth after suckers have broken through the soil surface. Suckers arising from the roots of decaying trees will not be

infected by the parent, as heart rot ends at the base of the stump, but deteriorating clones produce much less suckers than healthy clones (USDA 1990).

Aspen can grow to a maximum age of about 200 years under good conditions However, it is beset by numerous pathogens and, on the RGNF, generally reaches maximum age at 120-140 years Though historical documentation is limited, it appears that extensive burning in the late 1800s stimulated a profusion of aspen growth Much of that aspen has *now reached maturity, and is being replaced by younger clones or invading conifers* Research conducted in the Intermountain states (mostly Arizona, New Mexico, Colorado, and Utah) concludes that aspen-dominated stands are in decline[1] due to the lack of disturbance by fire. Assuming similar trends are occurring on the RGNF, it is possible that aspen stands are, in fact, in a decline

Other Forest Cover Types

The remaining 4% of the Forest dominated by tree cover includes the pinyon pine/Rocky Mountain juniper cover type (2.6%), bristlecone pine cover type (1 1%), and the limber pine, white fir, blue spruce, and cottonwood cover types, collectively making up less than 1%. These cover types are generally found occupying unique environments and provide important biological diversity The pinyon/juniper cover type is an especially important component of winter habitat for wildlife The cottonwood cover type gives cover and stability to riparian and wetland vegetation

[1] Kaufmann et al (1994) found in the Forest Service's Southwestern Region (Arizona/New Mexico) that " roughly half of the aspen stands have experienced significant ingrowth during the last 25 years" Mueggler) states· "Almost one-fourth of the aspen stands sampled within the Intermountain Region contained sufficient amounts of conifers to suggest that the aspen overstory would be replaced relatively rapidly by conifers, barring perturbations that set back succession," and goes on to say, "Although most even-aged aspen in the West appears to have arisen following severe fire, DeByle et al (1987) determined that currently only about 0 009% of the aspen type in the interior West is burned annually by wildfire ," and further states, "During the past decade, both the Rocky Mountain and Intermountain Regions of the U S Forest Service have been clear-cutting or burning approximately 600 ha/year [hectares per year] specifically to regenerate aspen These are little more than token amounts "

Threatened and Endangered Plants

The *Endangered Species Act* requires the Forest Service to manage habitat so that those species listed as threatened or endangered are not jeopardized.

There are presently no known federally listed threatened, endangered, or proposed plant species on the Rio Grande National Forest (USDI Fish and Wildlife Service 1994, USDI Fish and Wildlife Service 1996) Activities on the RGNF are not expected to have any impacts on Federally listed plants outside the RGNF boundary

Sensitive Plants, Special Concern Plants, and Significant Plant Communities

ABSTRACT

There are nine designated sensitive plants on the Forest There are 40 special concern plants (includes sensitive plants) and six significant plant communities recognized by the Colorado Natural Heritage Program (CNHP) for the Forest There are nine species with high occurrence on the RGNF relative to the Tri-Section. These plants have low occurrence documentation on the RGNF, but this is probably due to low search effort on the Forest and within the Tri-Section. There is no information to indicate that these plants are restricted to specific habitat conditions unique to the RGNF There are nine special concern plants which are ranked globally imperiled None of these species is geographically limited to the RGNF None of these species is found in habitat that only occurs on the RGNF. Six significant plant communities are recognized by CNHP as typical examples of the community None of these communities is uncommon on the RGNF Since all proposed activities are projected to minimally alter habitat, the majority of the RGNF landscapes proceed to change through natural processes Thus, sensitive plants, special concern plants, and significant plant communities should be able to perpetuate themselves under any Alternative

INTRODUCTION

Legal Framework

The *Endangered Species Act* requires the Forest Service to manage habitat so that those species listed as threatened or endangered are not jeopardized

SENSITIVE PLANTS

The Regional Forester designated sensitive plants for the Rocky Mountain Region on March 19, 1993 These are plants where a population viability concern has been raised Sensitive plants are known to occur on the Forest and they occupy a variety of habitats Sensitive plants are shown in **bold** type in the tables throughout this section Appendix E contains descriptions and known geographic distributions in Colorado of the Sensitive plants known on the Forest

Any Forest Service or proponent-proposed action is to be evaluated in a Biological Evaluation in sufficient detail to determine how an action will affect any species listed under the Endangered Species Act, proposed for such federal listing, or designated in the Rocky Mountain Region as sensitive

Special concern plants are identified by the Colorado Natural Heritage Program (CNHP). The CNHP also recognizes rare or exemplary plant communities (called significant natural plant communities) These communities are either rare, as defined by the CNHP's ranking methodology, or are typical examples of the plant community. More detail on these species and communities is presented in Appendix E The CNHP ranking methodology is explained in Appendix E, also

In addition, there are two botanical areas proposed based on sensitive plant populations on the Forest These are described in the Special Interest Area section of this Chapter

AFFECTED ENVIRONMENT

There are 40 special concern plants identified by the CNHP. Nine of these species are designated Sensitive plants in the Rocky Mountain Region Special concern species that are not designated sensitive do not have legal status nor are they officially recognized by Forest Service policy or Manual direction They are, however, a component of the biological diversity of the RGNF Many of these species' occurrences are not well-documented, and therefore, are included on the CNHP list due to a lack of occurrence records Consequently, it is important to better understand the rarity of these species and evaluate if any of these special concern plants are restricted in geographic distribution or in habitat requirements

Special concern plants reported on the RGNF are presented alphabetically with general vegetation zone and general habitat displayed in Table 3-18

Table 3-18 Vegetation Zone and General Habitat for Special Concern Plants Reported on the RGNF

SCIENTIFIC NAME	COMMON NAME	VEGETATION ZONE [1/]	GENERAL HABITAT [2/]
Aquilegia saximontana	Rocky Mountain columbine	A	rocky
Aster alpinus var *vierhapperi*	alpine aster	A	grassland
Astragalus brandegei	Brandegee milkvetch	M	open forestland
Astragalus ripleyi	**Ripley milkvetch**	M	open forestland
Botrychium echo	**echo moonwort**	S	open forestland
Botrychium hesperium	western moonwort	S	open forestland
Botrychium lanceolatum var *lanceolatum*	lance-leaved moonwort	S	open forestland
Botrychium lunaria	moonwort	S	open forestland
Botrychium pallidum	**pale moonwort**	S	open forestland
Carex limosa	mud sedge	S	wetland
Chionophila jamesii	Rocky Mountain snowlover	A	grassland
Comarum palustre	marsh cinquefoil	S	wetland
Corydalis caseana ssp *brandegei*	sierra corydalis	S	wetland
Crepis nana	dwarf hawksbeard	A	grassland
Crytogramma stelleri	slender rock-brake	M	forestland
Cystopteris montana	mountain bladder fern	M	wetland
Draba exunguiculata	clawless draba	A	grassland
Draba fladnizensis	arctic draba	A	wet to dry grassland
Draba graminea	San Juan whitlow-grass	A	grassland to rocky
Draba grayana	Gray's Peak whitlow-grass	A	rocky
Draba rectifructa	mountain whitlow-grass	M	open forestland
Draba smithii	**Smith whitlow-grass**	S	rocky
Draba spectabilis var *oxyloba*	none	S	open forestland
Draba streptobrachia	Colorado Divide whitlow-grass	A	rocky
Eriogonum brandegei	Brandegee wild buckwheat	F	open forestland
Eriophorum altaicum var *neogaeum*	Altai cottongrass	A	wetland
Eriophorum gracile	slender cottongrass	A	wetland
Gilia penstemonoides	**Black Canyon gilia**	M	rocky
Goodyera repens	dwarf rattlesnake plantain	M	forestland
Ipomopsis multiflora	many-flowered gilia	F	open forestland
Isoetes echinospora	none	S	wetland
Lilium philadelphicum	wood lily	M	forestland
Machaeranthera coloradoensis	**Colorado tansy-aster**	S	grassland

SCIENTIFIC NAME	COMMON NAME	VEGETATION ZONE [1/]	GENERAL HABITAT [2/]
Neoparrya lithophila	**rock-loving neoparrya**	F	rocky
Platanthera sparsiflora var ensifolia	canyon bog-orchid	M	wetland
Potentilla ambigens	southern Rocky Mountain cinquefoil	S	grasslands
Pyrola picta	pictureleaf wintergreen	M	forestland
Senecio dimorphophyllus var *intermedius*	different groundsel	S	edge of wetlands
Stellaria irrigua	Altai chickweed	A	rocky
Woodsia neomexicana	none	M	rocky

[1/] This is the reported vegetation zone where the plant was found on the RGNF Please note that some plants do not strictly align themselves to one zone
A = Alpine Zone -- >= 11,800 feet
S = Subalpine Zone -- 10,000 - 11,800 feet
M = Montane Zone -- 8,000 - 10,000 feet
F = Foothills Zone -- <= 8,000 feet

[2/] This is the general habitat where the plant was found on the RGNF Please note that some plants do not precisely align themselves to one habitat
Grassland—grass-dominated lands
Shrubland—shrub-dominated lands
Forestland—forest-dominated lands
Open—a modifier for forestland meaning park-like and very sparse tree canopy coverage
Wetland—water saturated at some time during the growing season sufficient to influence plant composition
Rocky—means rock outcrop, scree, talus, or fell-field

Few special concern plants are found in the foothills zone Most of special concern plants are found in open forestland Table 3-19 shows a summary of Special Concern Plants grouped by habitats and vegetation zones

Table 3-19 Summary of the number of Special Concern Plants grouped by habitats and vegetation zones

GENERAL HABITAT [2/]	VEGETATION ZONE [1/]				TOTAL
	ALPINE	SUBALPINE	MONTANE	FOOTHILLS	
Grassland	6	3 (1)	0	0	9
Shrubland	0	0	0	0	0
Forestland	0	0	4	0	4
Open Forestland	0	6 (2)	3 (1)	2 (1)	11
Rocky	4	1 (1)	1 (1)	1 (1)	7
Wetland	2 (1)	4	3	0	9
TOTAL	12	14	11	3	40

[1/] See footnote for Table 3-18 [2/] See footnote for Table 3-18
NOTE The "( )" indicate the number of sensitive plant species

The subalpine zone contains the most special concern plant species The most common habitat is open forestland None of the special concern plants occur in habitat found only on the RGNF (CNHP 1994)

An occurrence context is displayed next for each plant species on the Forest by showing the records on the RGNF, Tri-Section, and Province (Table 3-20) The purpose of this table is to determine if any special concern plants occur only on the RGNF, based on available information Sensitive plants are shown in **bold** type

Table 3-20 Number of population occurrences of Sensitive and Special Concern Plants on the RGNF, Tri-Section, and Province

SPECIES	NUMBER OF OCCURRENCES			RGNF Abundance Percent [1/]
	Province	Tri-Section	RGNF	
Aquilegia saximontana	23	1	1	100%
Aster alpinus var *vierhapperi*	3	1	1	100%
Astragalus brandegei	5	5	2	40%
Astragalus ripleyi	42	42	9	21%
Botrychium echo	17	4	1	25%
Botrychium hesperium	12	4	2	50%
Botrychium lanceolatum var *lanceolatum*	11	6	2	33%
Botrychium lunaria	19	2	1	50%
Botrychium pallidum	5	3	1	33%
Carex limosa	12	2	2	100%
Chionophila jamesii	14	4	2	50%
Comarum palustre	16	3	1	33%
Corydalis caseana ssp *brandegei*	33	30	5	17%
Crepis nana	21	11	1	9%
Crytogramma stelleri	10	6	1	17%
Cystopteris montana	8	5	1	20%
Draba exunguiculata	13	1	1	100%
Draba fladnizensis	21	6	3	50%
Draba graminea	8	8	2	25%
Draba grayana	11	2	2	100%
Draba rectifructa	2	2	2	100%
Draba smithii	8	8	5	63%
Draba spectabilis var *oxyloba*	14	12	6	50%
Draba streptobrachia	18	8	2	25%
Eriogonum brandegei	8	3	1	33%
Eriophorum altaicum* var. *neogaeum	12	10	2	20%
Eriophorum gracile	unknown	14	1	7%
Gilia penstemonoides	unknown	22	2	9%
Goodyera repens	unknown	25	1	4%

Table 3-20 Continued				
Ipomopsis multiflora	1	1	1	100%
Isoetes echinospora	5	4	4	100%
Lilium philadelphicum	36	13	1	8%
Machaeranthera coloradoensis	unknown	15	2	13%
Neoparrya lithophila	12	11	2	18%
Platanthera sparsiflora var *ensifolia*	14	9	1	11%
Potentilla ambigens	5	3	3	100%
Pyrola picta	16	4	1	25%
Senecio dimorphophyllus var *intermedius*	10	10	3	30%
Stellaria irrigua	9	9	2	22%
Woodsia neomexicana	8	6	1	17%
[1] RGNF occurrence divided by Tri-Section occurrence				

Plants with a high RGNF occurrence relative to the Tri-Section could indicate a habitat preference for the RGNF However, none of the above species' geographic distribution is limited to only one Colorado county, except *Ipomopsis multiflora* and *Astragalus ripleyi* The former plant is globally known in New Mexico to southern Nevada and Arizona, and the latter plant is globally known from northern New Mexico (CNHP 1994) See Appendix E for a listing of known occurrences, by Colorado counties, for each special concern plant species

Plants shown in Table 3-20 with a moderately high (70% or higher) RGNF occurrence relative to the Tri-Section are as follows 1) *Aquilegia saximontana*, 2) *Aster alpinus* var *vierhapperi*, 3) *Carex limosa*, 4) *Draba exunguiculata*, 5) *Draba grayana*, 6) *Draba rectifructa*, 7) *Ipomopsis multiflora*, 8) *Isoetes echinospora*, and 9) *Potentilla ambigens* These plants have low occurrences on the RGNF, but this is probably due to low search effort on the Forest There is no information to indicate that these plants are restricted to specific habitat conditions found only on a specific portion of the RGNF (CNHP 1994) On the contrary, these species (except *Ipomopsis multiflora* and *Astragalus ripleyi*) are found in several counties in Colorado (see Appendix E) and in habitat that is not limited on the Forest (CNHP 1994)

Appendix E includes a global- and state-rarity ranking for all special concern plants The ranking system follows CNHP methodology and helps describe how rare (or relatively common) each plant species is known to be in the state and in the rest of the world The global ranking provides a good estimation for how rare a plant is currently believed to be, based on known occurrence data Ten species have global rankings of G2 (globally imperiled—see Appendix E for full definition) or rarer

If the Global ranking is unknown, then the state ranking had to be critically imperiled for a plant to be evaluated here Special concern plants meeting these criteria are as follows (1) *Aster alpinus* var *vierhapperi*, (2) *Botrychium echo*,(3) *Botrychium pallidum*, (4) *Draba graminea*, (5) *Draba grayana*, (6) *Draba smithii*, (7) *Eriogonum brandegei*, (8) *Machaeranthera coloradoensis*, and (9) *Neoparrya lithophila* An evaluation for this specific group of plants is appropriate Two questions are relevant for these species, one, are any of

these plants restricted to the RGNF, and two, are any of these plants restricted to highly specialized habitat conditions?

The first question is answered by looking at the Colorado county distribution occurrence records for these plants (shown in Appendix E). Upon inspection, all of them have reported occurrences in other counties off the RGNF

The second question asks if any of the plants require very specialized habitat requirements Each of the nine species listed above is assessed below as follows:

Aster alpinus var *vierhapperi* occurs in the Alpine Sedges and Forbs on Alpine Summits Landtype Association (LTA 4). There is over 250,000 acres of this LTA on the Forest, and at least double this acreage in the Tri-Section This plant is found in grassy to stony alpine tundra (CNHP 1994) There is an abundance of potential habitat for this species.

Botrychium echo and *Botrychium pallidum* occur in Engelmann Spruce on Mountain Slopes Landtype Association (LTA 1) with relatively open canopy. There is over 900,000 acres of this LTA on the Forest. In addition, much of the open-spruce cover type in the Tri-Section provides potential habitat These species are extremely small and difficult to see This, in part, probably explains the low occurrence records

Draba graminea and *Draba grayana* occur in Alpine Sedges and Forbs on Alpine Summits (LTA 4) There is a quarter of a million acres of this alpine LTA on the RGNF There is at least double this acreage in the Tri-Section Both of these plants prefer rocky habitat, of which there appears to be adequate acreage available

Draba smithii occurs in rocky montane to subalpine habitats It is found in Arizona Fescue on Mountain Slopes Landtype Association (LTA 8) and Thurber Fescue on Mountain Slopes Landtype Association (LTA 9) The specific habitat appears to be limited, but it is considered safe from habitat alteration due to the relative inaccessibility and rockiness of the locations (CNHP 1994)

Eriogonum brandegei probably does not occur on the Forest. The reported location on the RGNF does not contain suitable habitat for this plant The location description from the reported occurrence record is judged to be in error (O'Kane 1988). Therefore this analysis will consider *E brandegei* not occurring on the RGNF.

Machaeranthera coloradoensis is a low, prostrate, mat-forming plant found on gravelly sites It is found in the more gravelly habitats of Arizona Fescue on Mountain Slopes Landtype Association (LTA 8) and Thurber Fescue on Mountain Slopes Landtype Association (LTA 9) It is an endemic species of south-central Wyoming and western Colorado Harrington (1954) documents this plant occurring in south-central, west-central, and southwestern parts of Colorado from 9,000 to 11,000 feet Habitat does not appear to be limited

Neoparrya lithophila is also found in the Pinyon on Mountain Slopes Landtype Association (LTA 6), but it appears to be more restrictive in habitat requirements. It prefers late-Tertiary volcanic dikes, lava flows, and igneous outcrops. It is endemic to south-central Colorado The habitat is very rocky and precludes most human and livestock uses (CNHP 1994)

Table 3-21 shows the six significant plant communities identified by the CNHP

Table 3-21. Significant Natural Plant Communities on the RGNF

Significant Natural Plant Communities on the RGNF	
Community Common Name	**Scientific Name**
1) Arizona fescue-slimstem muhly	*Festuca arizonica-Muhlenbergia filiculmis*
2) Arizona fescue-mountain muhly	*Festuca arizonica-Muhlenbergia montana*
3) bristlecone pine/Arizona fescue	*Pinus aristata/Festuca arizonica*
4) pinyon pine-(one-seed juniper)/ scribner needlegrass	*Pinus edulis-(Juniperus monosperma)/ Stipa scribneri*
5) ponderosa pine/Arizona fescue	*Pinus ponderosa/Festuca arizonica*
6) Douglas-fir/common juniper	*Pseudotsuga menziesii/Juniperus communis*

Plant Communities 1, 2, 3, 5, and 6 above are found in the Montane Zone on the Forest Plant Community 4 is found in the Foothills Zone on the Forest None of the communities listed in Table 3-21 is uncommon on the RGNF "Significant Plant Community," in this case, means it is a typical example of the plant community Because these communities are common, there appear to be no immediate threats to them Appendix E contains additional information on these plant communities

RESOURCE PROTECTION MEASURES

Biological Evaluations (BEs) are done at the project level to address the effects of proposed activities on Sensitive plants The following are general measures that may be employed to mitigate impacts to Sensitive plants:

* reduce the impact on Sensitive plants by avoiding the plants or habitat,
* limiting the degree or magnitude of the impact,
* reduce impacts by changing the timing,
* repair, rehabilitate, or restore following the action,
* compensation by creating or enhancing nearby habitat, or
* alternative methods to achieve a project goal

The following are mitigation measures specific to the Forest Plan Revision. Some or all of them may be employed under various Alternatives

* Land allocations containing Sensitive plants, special concern plants, or significant plant communities with no programmed timber harvest or other ground-disturbing activities Examples are Management Emphasis Categories 1 through 4 (a description of categories is provided in the Environmental Consequences section next) These categories generally allow natural processes to occur, which should favor natural perpetuation of plants

* Restrictions placed on the use of whole-tree harvesting based on soil limitations

* Vegetation-utilization and -residue guidelines

* Establishment of Special Interest Areas (Botanical Areas) to specifically emphasize the protection of botanical values.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Habitat requirements and plant species' response to management activities are poorly understood. Thus, an assumption is made that Alternatives that least alter natural landscape composition, structure, and function are generally deemed more desirable for perpetuation of all plant resources, including special concern plants and significant plant communities Management Emphasis Categories, by Alternative, include a general estimation of potential vegetation manipulation and ground disturbance The Management Emphasis Categories are summarized as follows.

Category 1	Ecological processes dominate.
Category 2	Conservation of representative/rare ecological settings
Category 3	Ecological settings with minimal human use
Category 4	Ecological values with recreation-oriented use
Category 5	Forested ecosystems managed for a variety of needs
Category 6	Grassland ecosystems managed for a variety of needs
Category 7	Intermingled lands
Category 8	Ecological alterations are permanent

The higher the category number, in general, the higher the potential risk for habitat alteration Thus, each category gives a very broad, generalized estimation of potential special concern plant or significant plant community habitat alteration However, it needs to be clear that just because a plant species or community occurs within a Management Emphasis Category five through eight does not automatically mean that its habitat will be altered It simply means that it is in an allocation where a portion of the allocation could potentially be susceptible to some degree of habitat manipulation Livestock grazing and recreation impacts are not adequately accounted for in this scheme and are addressed separately in their respective effects sections below

The Management Emphasis Categories were recorded, by Alternative, for each known special concern plant location on the Forest. Then, a frequency was calculated for each plant species to see how often it occurred in Management Emphasis Categories 1, 2, 3, or 4 Generally, most of the potential habitat alteration occurs in categories five through eight. Table 3-22 shows the frequency of all RGNF population occurrences by special concern plant species by Management Emphasis Categories one through four A 100% in the table means that all the known populations for a plant species on the RGNF are allocated to Management Emphasis Categories 1, 2, 3, or 4 Please note that this table only accounts for known populations and could not assess all potential habitat for these species

Table 3-22. Management Emphasis Categories one through four occurrence frequency, by Alternative, for special concern plants

SPECIAL CONCERN PLANTS	No of reported populations on the Forest (sample size)	Management Emphasis Categories 1-4 Occurrence Frequency (%) by Alternative						
		A	B	D	E	F	G	NA
Aquilegia saximontana	1	100	0	100	100	100	100	0
Aster alpinus var *vierhapperi*	1	100	0	0	0	100	0	0
Astragalus brandegei	2	50	50	50	50	50	50	0
Astragalus ripleyi	9	78	67	67	56	78	67	22
Botrychium echo	1	100	100	100	100	100	100	0
Botrychium hesperium	2	100	100	100	100	100	100	0
Botrychium lanceolatum var *lanceolatum*	2	50	50	100	50	50	100	50
Botrychium lunaria	1	0	0	100	0	0	100	0
Botrychium pallidum	1	100	100	100	100	100	100	0
Carex limosa	2	100	100	100	50	100	100	50
Chionophila jamesii	2	100	100	100	100	100	100	100
Comarum palustre	1	100	100	100	100	100	100	0
Corydalis caseana ssp *brandegei*	5	100	60	80	80	100	80	40
Crepis nana	1	100	100	100	100	100	100	100
Crytogramma stelleri	1	100	100	100	100	100	100	100
Cystopteris montana	1	0	0	0	0	100	0	100
Draba exunguiculata	1	100	0	100	100	100	100	0
Draba fladnizensis	3	67	67	67	67	67	67	67
Draba graminea	2	50	50	50	50	100	50	100
Draba grayana	2	100	100	100	100	100	100	100
Draba rectifructa	2	0	0	0	0	0	0	0
Draba smithii	5	80	40	80	80	80	80	40
Draba spectabilis var *oxyloba*	6	83	83	83	83	83	83	67
Draba streptobrachia	2	100	100	50	100	100	100	50
Eriogonum brandegei	1	0	0	0	0	0	0	0
Eriophorum altaicum* var *neogaeum	2	100	100	100	100	100	100	50
Eriophorum gracile	1	100	100	100	100	100	100	100
Gilia penstemonoides	2	100	100	100	100	100	100	100
Goodyera repens	1	100	100	100	100	100	100	100
Ipomopsis multiflora	1	100	0	0	0	100	0	0
Isoetes echinospora	4	100	100	100	100	100	100	100

Table 3-22, continued								
Lilium philadelphicum	1	0	0	0	0	0	0	0
Machaeranthera coloradoensis	2	100	100	100	100	100	100	100
Neoparrya lithophila	2	100	100	100	100	100	100	0
Platanthera sparsiflora var *ensifolia*	1	100	100	100	100	100	100	100
Potentilla ambigens	3	33	67	67	67	67	67	0
Pyrola picta	1	100	100	100	100	100	100	100
Senecio dimorphophyllus var *intermedius*	3	100	67	33	67	100	33	0
Stellaria irrigua	2	100	100	100	100	100	100	100
Woodsia neomexicana	1	100	100	100	100	100	100	100
AVERAGE FOR ALL SPECIES		80%	68%	76%	73%	84%	77%	48%

Table 3-22 above summarizes how each special concern plant was allocated by Alternative Some Alternatives allocate more areas to Management Emphasis Categories 1, 2, 3, or 4 than others However, there is no information to indicate that any Alternative does not provide sustainable habitat for each special concern plant

The management emphasis categories were recorded, by Alternative, for the six significant plant communities (Table 3-23). Then, a frequency was calculated for each community to see how often it occurred in Management Emphasis Categories 1, 2, 3, or 4 Additional information on these communities is provided in Appendix E

Table 3-23. Managment Emphasis Categories one through four occurrence frequency, by Alternative, for significant plant communities

PLANT COMMUNITY	No of Reported Communities on the Forest (Sample Size)	OCCURRENCE FREQUENCY (%) OF MANAGEMENT EMPHASIS CATEGORY 1-4 BY ALTERNATIVE						
		A	B	D	E	F	G	NA
Arizona fescue-slimstem muhly	1	100	100	100	100	100	100	0
Arizona fescue-mountain muhly	1	0	0	0	0	100	0	0
Bristlecone pine/Arizona fescue	3	100	100	100	100	100	100	67
pinyon pine-(one-seed juniper) / scribner needlegrass	1	100	100	100	100	100	100	100
Ponderosa pine/Arizona fescue	3	67	33	67	67	100	67	0
Douglas-fir/common/common juniper	1	0	0	0	0	0	0	0
AVERAGE FOR ALL COMMUNITIES		61%	56%	61%	61%	83%	61%	28%

Table 3-23 above summarizes how each significant plant community was allocated by Alternative. Again, some Alternatives simply allocate more areas to Management Emphasis

Categories 1, 2, 3, or 4 However, there is no information to indicate that any Alternative does not provide sustainable habitat for each significant plant community

Effects on Plants from Timber Management

Timber management could result in direct species loss or habitat alteration Conversely, timber management could result in improved habitat conditions for certain species (e g , moonworts [*Botrychium* sp] appear to prefer some sites which have been harvested in the past)

Timber harvest can result in habitat modification including skidding, decking, site preparation, slash piling, road construction and maintenance, and tree removal Whole-tree harvesting methods reduce the amount of organic matter on a site and could result in an adverse impact to some species. Mitigation used to meet the downed log standard and avoidance of individual populations would minimize these impacts.

Since our knowledge of each species' reaction to timber management is not known, effects determination focuses on the likelihood of habitat being altered The assumption is that naturally functioning landscapes perpetuate special concern plants and significant communities, due to limited, detailed species information to indicate otherwise Tables 3-22 and 3-23 show the frequency that each Sensitive, special concern plant, and significant plant community occurs within Management Emphasis Categories 1 through 4 The reader can see the percentage of occurrence that reported locations for plants and communities occur within categories one through four, by Alternative

Table 3-19 shows generalized vegetation zones and habitat for all special concern plants This provides a perspective on which plants could be more susceptible to potential timber harvest The majority of the potential timber harvest, regardless of Alternative, would occur in the subalpine zone There are no Sensitive, special concern, or significant plant communities in subalpine closed-canopy forestland (Table 3-19) There are some plant species found in open forestland (very sparse tree canopy), but there would be very low risk to these plants In the montane zone, there are four plants found in closed-canopy forestland, *Cryptogramma stelleri, Goodyera repens, Lilium philadelphicum,* and *Pyrola picta* There is over 94,000 acres of white fir and Douglas-fir on Mountain Slopes Landtype Association (LTA 3) on the Forest Only 14% of this LTA is projected to be harvested over the next 200 years under Alternative NA at full budget levels All other Alternatives, and by experienced budgets, harvest less Thus, these plants and their habitat appear to be at low risk of habitat alteration

In addition, this means the risk to significant plant communities would also be very low since the majority of the projected harvest occurs at higher elevations in closed-canopy forests None of the Alternatives appear to pose a significant impact on Sensitive plants, special concern plants, or significant plant communities

Mitigation to counter the effects of any project activity on Sensitive plants would be based on the results of a Biological Evaluation

Effects on Plants from Range Management

Activities related to range management can impact plants through habitat disturbance, modification, or a direct loss of individuals by grazing or trampling Impacts can be caused by overgrazing or modification of soil structure through compaction Soil compaction can lead to reduced infiltration rates and increased erosion These effects can lead to a drying-out of moist soils required by riparian or wetland plant communities

Livestock graze a large percentage of the Forest, so there is a possibility for direct loss of plants or habitat disturbance Livestock grazing has been occurring on the Forest since the 1800s and numbers were significantly higher, historically, than they are now (see RNV report Appendix A). Yet, the plants and significant plant communities known on the Forest have probably survived in the presence of grazing since this time However, it is not clear whether populations are changing or are constant under historical and present grazing practices

There are 35 vacant grazing allotments on the RGNF. Many of these are sheep allotments, which indicates a sharp decrease in sheep use of the alpine zone in the last two decades Consequently, domestic livestock grazing influence has decreased significantly in alpine ecosystems in recent years

Very little is known about special concern plant livestock palatability Therefore, this analysis evaluates the susceptibility of each species to livestock grazing Where grazing susceptibility appears probable, a determination is made of how much potential habitat is available. Next, a geographic distribution context is discussed to see if the RGNF is proposing to allow grazing the only known population Then, an estimation of palatability is made, if information is available Thus, this helps assess the risk placed on each special concern plant species due to livestock grazing

Plants strongly associated with rocky habitats are assumed to be relatively unavailable to livestock grazing Thus, plants listed in Table 3-18 associated with rocky habitats are judged to be at low risk from livestock grazing impact and are excluded from the analysis In addition, plants associated with closed-canopy forestland were also excluded from this analysis assuming that these habitats have low susceptibility to livestock grazing. Special concern plants not assessed (due to rocky habitat or closed-canopy forestland), and judged to be at low risk, were as follows *Aquilegia saximontana, Cryptogramma stelleri, Draba grayana, Draba smithii, Draba streptobrachia, Gilia penstemonoides, Goodyera repens, Lilium philadelphicum, Neoparrya lithophila, Pyrola picta, Stellaria irrigua, and Woodsia neomexicana*

The remaining special concern plants are evaluated below for their potential susceptibility to livestock grazing impact. In some cases, there was information available which estimated the energy and protein value of a genus. A poor rating was assumed to mean that the genus was not typically a preferred forage group The implication is, if the range is properly grazed, then plants in this genus should not normally be sought out by domestic herbivores Of course, this is not species specific, but this was the best information available

An evaluation of the special concern plants' susceptibility to livestock grazing follows. (sensitive plants are shown in **bold** font)

Aster alpinus var *vierhapperi*

This plant is found on grassy to stony slopes in the alpine tundra (CNHP 1994) At least part of the habitat may have low susceptibility to livestock grazing due to rockyness The *Aster* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species There is an abundance of alpine sedges and forbs on alpine summits habitat (LTA 4) available with much of it not currently grazed Since palatability is suspected to be low and extensive potential habitat is available, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species

Astragalus brandegei

This plant is found in sandy and gravelly soils in the foothills and montane zones on the Forest It is a G5 plant (demonstrably secure globally, CNHP 1996) The *Astragalus* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species. It is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species because of extensive potential habitat is available, this plant is globally very common, and it is probably not preferred by domestic herbivores

Astragalus ripleyi

This plant is found in open-canopy forestland in the montane zone Plants appear to be grazed by livestock, deer, elk, and rabbits In areas receiving heavy grazing pressure, robust plants may be found in the protection of shrub crowns (CNHP 1994) Not all known sites are receiving livestock grazing on the RGNF This plant has been exposed to livestock grazing for over 100 years and it is still present in the landscape It appears to be a mid-seral species requiring some level of disturbance for long-term perpetuation It is doubtful that proper livestock grazing is adversely impacting the long-term existence of this plant However, the RGNF is currently conducting a monitoring program cooperatively with the Bureau of Land Management, the State of Colorado, and Colorado State University to assess the impacts of livestock grazing on this plant

Botrychium echo

The *Botrychium* species on this list appear to be found in similar habitat on the RGNF, so they are treated collectively here They are typically found in gravelly soils in relatively open Engelmann Spruce on Mountain Slopes Landtype Association (LTA 1) There is an abundance of this habitat on the Forest, as has already been mentioned Peter Root's opinion is that rabbits and voles probably graze *Botrychium* species, but he is not aware of livestock grazing this genus (personal communication July 14, 1994 between Peter Root, *Botrychium* specialist, and Dean

	Erhard) Therefore, it is unlikely that this group of plants will be adversely impacted by proper livestock grazing
Botrychium hesperium	See *Botrychium echo*
Botrychium lanceolatum var *lanceolatum*	See *Botrychium echo.*
Botrychium lunaria	See *Botrychium echo*
Botrychium pallidum	See *Botrychium echo*
Carex limosa	This plant is found on floating moss mats in wetlands of the subalpine zone It is a G5 plant (demonstrably secure globally, CNHP 1996) This species is probably somewhat unavailable to livestock grazing, depending on the depth of water Since the global distribution is very common, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Chionophila jamesii	This plant is found in the alpine tundra on rocky, moist, steep slopes (CNHP 1994) At least part of the habitat may have low susceptibility to livestock grazing due to rockyness and slope There is an abundance of Alpine Sedges and Forbs on Alpine Summits (LTA 4) habitat available with much of it not currently grazed Since extensive potential habitat is available and the rocky and steep portions of the habitat are probably unglazed, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species.
Comarum palustre	This plant occurs on floating moss mats of wetlands, associated with *Carex limosa* habitat. It is a G5 plant (demonstrably secure globally, CNHP 1996) This species is probably somewhat unavailable to livestock grazing, depending on the depth of water. Since the global distribution is very common, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Corydalis caseana ssp *brandegei*	This plant is found in very moist riparian areas in the subalpine zone (CNHP 1994) It is a G5 plant (demonstrably secure globally, CNHP 1996) The *Corydalis* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species Since the global distribution is very common and it probably has low palatability, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species

Crepis nana	This plant is an alpine grassland species, its status is a G5 plant (demonstrably secure globally, CNHP 1996) The *Crepis* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species There is an abundance of alpine habitat (LTA 4) available with much of it not currently grazed It is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species due to global distribution being very common, palatability is suspected to be low, and extensive potential habitat is available
Cystopteris montana	This plant is a riparian and meadow species in the montane zone that is a G5 (demonstrably secure globally) plant (CNHP 1996). The *Cystopteris* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species. It is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species due to global distribution being very common, palatability is suspected to be low, and extensive potential habitat is available
Draba exunguiculata	This plant is an alpine species which occurs in rocky soils (CNHP 1994) At least part of the habitat may have low susceptibility to livestock grazing due to rocky soils The energy and protein value of *Draba* is not known There is an abundance of alpine habitat (LTA 4) available, however, with much of it not currently grazed Since extensive potential habitat is available and part of the habitat may be unaccessible to livestock, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Draba fladnizensis	This species occurs in dry to wet tundra and on well-developed soils to rocky habitats in the alpine It is a G4 (apparently secure globally) plant (CNHP 1996) At least part of the habitat may have low susceptibility to livestock grazing due to wetness and/or rockiness There is an abundance of alpine habitat (LTA 4) available with much of it not currently grazed It is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species due to global distribution being common, part of the habitat is inaccessible to livestock, and extensive potential habitat is available
Draba graminea	This species occurs in the alpine on bare ground, talus slopes, and in turf when conditions are appropriate (CNHP 1994) At least part of the habitat may have low susceptibility to livestock grazing due to rockiness There is an abundance of alpine habitat (LTA 4) available with much of it not currently grazed Since extensive potential

	habitat is available and part of the habitat may be inaccessible to livestock, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species.
Draba rectifructa	This species occurs on gravelly soil in mixed-conifer meadows and grasslands (CNHP 1994) in the montane zone This is an annual species which is distributed over the western part of Colorado. Since extensive potential habitat is available, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Draba spectabilis var. *oxyloba*	This species is found in a wide variety of habitats, from ponderosa pine communities to alpine tundra communities Its distribution is known over southwestern and west-central Colorado (CNHP 1994). Since extensive potential habitat is available, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species.
Eriogonum brandegei	This plant is found in sagebrush and pinyon/juniper communities on limestone to shale soils (CNHP 1994) As stated before, it is highly doubtful that this plant occurs on the RGNF (O'Kane 1988) Therefore, a risk of grazing impact on this species is not assessed
Eriophorum altaicum* var. *neogaeum	This plant occurs in wet habitats in the alpine (CNHP 1994). These plants are found in standing water on the RGNF There is an abundance of alpine habitat (LTA 4) with many potential areas capable of supporting this species. Many alpine landscapes are not currently grazed by livestock This species is probably somewhat unavailable to livestock, depending on the depth of water Since some of the habitat is not conducive to grazing and habitat does not appear to be limited, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Eriophorum gracile	See *Eriophorum altaicum* var. *neogaeum.*
Ipomopsis multiflora	This species occurs on sandy soils in the foothills zone It is broadly known from New Mexico to southern Nevada and Arizona (CNHP 1994) The *Ipomopsis* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species. Since the palatability is suspected to be low and extensive potential habitat is available, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species

Isoetes echinospora	This plant is found in standing water of lakes, ponds, and streams in the subalpine zone. It is a G5 (demonstrably secure globally) plant (CNHP 1996) This species is probably somewhat unavailable to livestock, depending on the depth of water Since some of the habitat is not conducive to grazing and habitat does not appear to be limited, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Machaeranthera coloradoensis	This plant is found in subalpine parks and dry tundra in gravelly habitats (Weber 1990) This low, prostrate mat-plant is known to grow on relatively barren slopes and ridges This plant probably is not at high risk from grazing, based on field observations in Wyoming (Fertig 1994). The feeling is that the plant is probably somewhat unpalatable Also, the sparseness of the habitat probably does not encourage animal use
Platanthera sparsiflora var *ensifolia*	This plant occurs in meadows, marshes, swamps, bogs, open or dense forests, stream banks, and springs (CNHP 1994) in the montane zone on the Forest This species is found scattered throughout the West Because of the wide range of habitat conditions and wide geographic distribution, it is doubtful that proper riparian grazing on the RGNF will lead to a detrimental impact on this species.
Potentilla ambigens	This plant occurs on grassy or coluvium slopes (CNHP 1994) in the montane and subalpine zones The plant is known globally from Wyoming to New Mexico The Potentilla genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species Since the palatability is suspected to low and the geographic distribution is large, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species
Senecio dimorphophyllus var *intermedius*	This plant is found on the edge of wet meadows in the subalpine zone It is known from Wyoming and Colorado (CNHP 1994) The *Senecio* genus is generally ranked poor for energy and protein value (Dittberner and Olson 1983), so it probably is not a preferred species. Since the palatability is suspected to be low and the potential habitat is not limiting on the Forest, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species

None of the significant plant communities are rare on the RGNF It is doubtful that proper grazing within these communities will lead to detrimental impacts

Mitigation used to properly graze forage will reduce the potential impacts of livestock grazing to Sensitive plants, special concern plants, and significant plant communities Possible adverse effects could be avoided through site-specific allotment planning and administration—such as movement from single-pasture, season-long grazing systems to multiple-pasture deferred-rotation systems

Range management practices can minimize the effects of livestock grazing on plants These include fencing, alternative water sources, and changes in grazing season (the timing of grazing impact)

The Animal Unit Month (AUM) stocking varies by Alternative from allocating the present full permitted numbers and seasons to stocking subordinate to wildlife needs Alternatives A and F propose the least AUM stocking and consequently reduce potential herbivore consumption of Sensitive plants, special concern plants, and significant plant communities

Mitigation to counter the effects of any project activity on Sensitive plants would be based on the results of a Biological Evaluation

Effects on Plants from Recreation Management

Recreation management activities can result in either direct habitat modification, loss, or direct loss of individual plants

Effects of dispersed recreation could include trampling vegetation, soil compaction, increased erosion and sedimentation from trails, recreational stock grazing (associated with hunting and horse-back riding activities) These activities, if not adequately controlled, could potentially adversely impact plants or their habitat

The RGNF, however, is the most lightly used Forest in the Tri-Section for recreation (see Tri-Section analysis for recreation) Recreation use, under all Alternatives, appears to have a relatively low impact on Sensitive plants, special concern plants, and significant plant communities on the Forest

Overuse around developed recreation sites, such as campgrounds, can cause deterioration of the vegetation, which can affect plant species However, this use appears to be insignificant on Sensitive plants, special concern plants, and significant plant communities on the Forest based on known occurrences and known habitats.

Off-highway motorized recreation use has the potential to directly impact individual plants or habitats The most vulnerable habitats, based on ease of access, are those associated with grasslands, riparian areas, and open forested communities. Vegetation can be damaged, without an opportunity to recover, where motorized use is concentrated, repeated, and frequent Restricting motorized use to roads and trails minimizes the potential impact to plants Authorized cross-country motorized use (travel off roads and trails) varies by Alternative Alternative B allows the most area open for motorized cross-country use while Alternatives A and F allow the least (see the authorized travel management, by Alternative, in the Travel Management section of this Chapter) Consequently, Alternative B has the highest potential for impacting special concern plants and communities There are no known areas containing special concern plants or communities where there is a known conflict with current off-highway motorized recreation. However, the question is, is there a

plant or community that is so narrowly restricted in habitat that it would be at high risk of population mortality from off-road motorized recreation? The answer is, there are no special concern plants or communities that are so narrowly restricted in habitat and also in susceptible habitats (grassland, riparian, and open forested communities) to off-road motorized recreation damage Therefore, there is no reason to believe that dispersed and infrequent cross-country motorized recreation will detrimentally impact the existence of special concern plants or significant plant communities on the RGNF

Trail development can directly remove plants through construction or usage The amount of new trail construction is projected to be three miles per year in all Alternatives except F, where there is no new construction This amount of disturbance is relatively low considering the size of the Forest Thus, trail construction appears to be insignificant on Sensitive plants, special concern plants, and significant plant communities on the Forest

Mitigation to counter the effects of any project activity on Sensitive plants would be based on the results of a Biological Evaluation

Effects on Plants from Minerals Exploration and Extraction:

Exploration for or development of locatable, leasable, and salable minerals could directly result in removal of plants or habitat, or indirectly alter plant habitat hydrology Mineral activity on the Forest is projected to be relatively low The total disturbance is projected to be 219 acres over the next ten years for Alternatives NA, B, D, E, and G The total disturbance for Alternatives A and F is only 69 acres This level of disturbance appears to be insignificant on Sensitive plants, special concern plants, and significant plant communities on the Forest

Mitigation to counter the effects of development on Sensitive species would be based on the results of a Biological Evaluation

Effects on Plants from Roads

Roads, like trails, can remove plants through road construction or resultant traffic Those Alternatives with larger increases in road mileage would have a higher potential for impact, whereas net decreases could potentially restore habitat, depending on the species Oil and gas development and hard rock mining propose an estimated 21 5 miles of new road construction, by Alternative, at both full and experienced budgets. Roads associated with timber harvest activity for Alternatives NA and B propose 49 miles and 64 miles of new roads, respectively, for the first decade at full budget At experienced budget levels, the road mileage is 1 mile and 3 miles for Alternatives NA and B, respectively All other Alternatives are less The locations of proposed roads are unknown, since mileage is based on estimated timber volume harvested, estimated oil and gas development, and estimated hard rock mining development, by Alternative Most of the new roads would primarily impact subalpine closed-canopy forestland (Table 3-19). There are no Sensitive, special concern plants, or significant plant communities in this habitat See Effects—from Timber Management for more discussion

Mitigation to counter the effects of any project activity on Sensitive plants would be based on the results of a Biological Evaluation

Effects on Plants from Fire Management

Wildfire could have a variety of effects on plants There could be beneficial or detrimental impacts depending on the intensity, size, season, and other factors The specific relationship of fire to each plant species is not well understood All of the Landtype Associations (LTAs) within the Forest boundary evolved under a specific fire regime. Thus, elimination or significant reduction of fire could be detrimental to some plants in the long-run

Wildfires can seriously impair watersheds, especially after intense burns There can be increased potential for sheet erosion, gully formation, and slumping This is most acute where bare mineral soil is exposed. This can result in early successional vegetation (e g , lambsquarter, wild tarragon, Canada thistle, and others) which could strongly compete with Sensitive and special concern plants Watershed restoration following fire could result in seeding, water-barring, mulching, and construction of erosion control structures to mitigate the impact of wildfire.

Prescribed fire can have the same effects mentioned above if certain mitigation measures are not implemented These measures include avoidance of critical areas, managing fire intensity and severity by adjusting lighting patterns and/or monitoring the moisture of the soil and fuels (live and dead) Knowledge of the plant's physiology and seasonal variations in its sensitivity to fire is also critical Those lower-elevational LTAs that evolved under a more frequent burning regime have typically had fire suppressed this century These LTAs are potentially in need of prescribed fire to maintain natural ecosystem composition, structure, and function

Six special concern plants might benefit from prescribed fire in the next few decades *Astragalus brandegei, Astragalus ripleyi, Draba rectifructa, Eriogonum brandegei, and Ipomopsis multiflora* These species are associated with foothills and montane vegetation zones and are found in open forestland, shrublands, or grasslands Other vegetation zones and habitats are probably less in need of prescribed fire Presumably, prescribed fire would be beneficial to all the significant plant communities, since they are all lower elevational communities

The amount of management-ignited fire acreage will be the same for all Alternatives, but the potential for developing prescribed natural fire areas will be greater in Alternatives A and F (see the Fire section in this chapter) Presumably, a closer approximation to the natural fire regime will benefit ecosystem diversity and, thus, indirectly benefit Sensitive plants, special concern plants, and significant plant communities

Mitigation to counter the effects of any project activity on Sensitive plants would be based on the results of a Biological Evaluation

Effects on Plants from Special Area Designation

There are two botanical areas proposed for two Sensitive plant species on the Forest—*Astragalus ripleyi* and *Neoparrya lithophila.* The designation of these areas would result in increased protection and monitoring of these Sensitive plants. The botanical areas are common to all Alternatives except NA. The acreage of the allocation varies somewhat by Alternative. See the section on Special Interest Areas in this Chapter for more information

CUMULATIVE EFFECTS

Global rankings indicate rarity for nine plant species (G2—imperiled globally) and for none of the plant communities Of those species that are globally imperiled, none are restricted to habitat that is critically limited on the RGNF *Draba smithii* and *Neoparrya lithophila* are in habitat that appears to be the most limiting on the RGNF No proposed management activities are threatening these species

All special concern plants occur in other counties in Colorado or New Mexico, indicating a wider distribution than the Forest Since all proposed activities are projected to minimally alter habitat, the majority of the RGNF landscapes will proceed to change through natural processes Thus, Sensitive plants, special concern plants, and significant plant communities should be able to perpetuate themselves under any Alternative

Fragmentation and Connectivity

ABSTRACT

The current interest in forest fragmentation has its roots in the theory of island biogeography, published in the 1960s This theory stated that larger islands usually have more species than smaller islands, the more remote the island the fewer the species it has, and when the islands are colonized, the new colonists will replace species that have become extinct

The theory was thought to be applicable to the islands of habitat created by fragmenting contiguous forest stands into small forest patches (such as those caused by logging and road building) The resulting landscape becomes "islands" of habitat surrounded by conditions hostile to movement between them, thereby isolating the species that inhabit them Eventually this could lead to problems with species viability Because of the tremendous range in species' ability to disperse and use habitats, any discussion of fragmentation needs to address particular species

There are three primary concerns about forest fragmentation patch isolation, patch size, and edge effects Two strategies have been proposed to address the impacts of fragmentation The first is to create corridors that connect the forest patches. The second is to foster the necessary attributes that enable species to get from patch to patch without the need of corridors

The situation that has unfolded in the Northeast and Pacific Northwest, with the impacts *from fragmentation and loss of connectivity, cannot be extrapolated to the RGNF today, or* for the planning period The reasons are the small amount of clearcut and/or overstory timber harvests (existing and planned, by Alternative), the ample amount of undeveloped areas, and the abundance of late-successional forest on the RGNF

Because the viability of the larger wildlife species requires habitat beyond the RGNF boundary, we looked for any potential corridors that link the Forest to surrounding areas We took a conservative approach and said that any obvious narrowing or constriction of forested cover was a potential corridor Five potential corridors were identified To assess the risk of making the corridors unsuitable for species dispersal, six criteria were used ownership, width, recreational use, road density, presence of paved highways, and suitable timberlands

No Alternative will alter any of the five potential corridors in such a way as to preclude species movement beyond the RGNF, although during hunting season there could be enough use to impede species movement temporarily

INTRODUCTION

Fragmentation

In the mid-1960s, the theory of island biogeography was published Basically, the theory surmised that larger islands usually have more species than smaller islands, the more remote the island the fewer the species it has, and when the islands are colonized, the new colonists will replace species that have become extinct

The theory was thought to be applicable to "islands" of habitat on the mainland (Gorman 1979 and Harris 1984) The rationale was that as contiguous forests were harvested and roaded, the remaining patches of habitat would become like islands with the subsequent loss of biological diversity The main focus of attention was the islands composed of late-successional forests

This theory gave rise to the present-day concerns about forest fragmentation (Shafer 1990) For this analysis, the definition of fragmentation will follow that found in Saunders et al (1991), McIntrye and Barrett (1992), and Harris and Silva-Lopez (1992)· habitat remnants (islands) surrounded and isolated by conditions that are hostile for species to move from one remnant to another

Europe, the Northeastern U.S , and the Pacific Northwest are cited as examples of where extensive forest fragmentation has occurred. In Europe and the Northeastern U.S vast tracts of forest have been converted to unforested conditions (e g. farmlands, towns, and cities) In the Pacific Northwest, the forests have been heavily clearcut, and some people argue that the clearcuts have forever altered the ability of the land to become a late-successional forest again The result is that vast expanses of forested habitat have been converted into small patches of forest that are surrounded by human disturbances

Morrison et al (1992) offer a good discussion on the applicability of the island biogeography theory to mainland or continental settings They feel the similarities are·

* The extinction rate is a function of increasing isolation, such as that caused by fragmentation and decreasing area Also, extinction rates are higher for habitat specialists (species tied to very specific habitat conditions) than generalists (species that can use a wide variety of habitats).

* Both settings are influenced by what is known as "the founder principle." This states that a single set of immigrating individuals can begin a local population in a previously unoccupied area. Related to this is the "rescue effect" whereby an immigrant fills a patch that was previously occupied but is currently unoccupied

* Both settings can undergo what is known as "faunal relaxation " This is a decline in species richness or occupancy This occurs when the environment changes faster than the species can respond demographically

They also felt, however, that there were some very important differences

* The land between the habitat islands may be suboptimal, but usable for dispersal, resting, or seasonal or annual migration The movement patterns become more complex for the habitat islands

* There are differences in the effects of patterns and the juxtaposition of the patches of habitat In continental landscapes, patch patterns directly affect occupancy rates and colonization dynamics, and therefore population persistence in an area Colonization and extinction processes become more complex in the continental landscape

* There is a difference in the effects of patch size Unlike a true island, even if a habitat island is smaller than necessary to provide key requirements for a particular species, it could still have valuable dispersal, feeding, cover, or resting conditions

Regardless of how closely habitat islands mimic true islands, studies which have shown some negative impacts to wildlife species resulting from forest fragmentation Wilcove (1988) discussed the numerous studies of small woodlots in the Northeast where bird populations declined Preliminary indications from Rosenberg and Raphael (1986) were that some species are Sensitive to the forest fragmentation in the Northwest Yahner, Morrell, and Rachael (1989) indicated that the edges created by forest fragmentation increased the level of predation on birds' nests

Current concerns over forest fragmentation are centered around three concepts·

Patch Isolation	The creation of small patches increases the risk of patches becoming isolated from each other This isolation may worsen if the area between the patches becomes inhospitable for species movement The inability to move between habitat patches may result in species extinctions in the isolated patches In addition, there would be limited recolonization of the vacant patches, since species could not move to them
Patch Size	Forest-interior species seek out conditions that are beyond the influence of edges, and as such require certain sizes of habitat patches As patches become smaller, they might not be able to meet the species' needs, resulting in a loss of these species from an area
Edge Effects	As patches become smaller, there is a increase in the amount of edges This could result in increased competition and predation from species adapted to edge habitats

In addition to timber harvesting, another potential fragmenting agent is roads They can become barriers to species movement because of their open nature and/or the amount of traffic they carry. Since they create edge habitat, they, too, can have edge effects We could not find any studies which indicated the larger species (i e., coyote-sized and larger) would not cross a road For the larger species, therefore, the presence of a road in and of itself does not impede wildlife movement. Elk and black bears have been found to be reluctant to cross major interstate highways (Ward et al. 1983, and Brody and Pelton 1989) The smaller species might find the mere presence of roads a major obstacle to movement (Noss 1991)

Connectivity

One strategy offered to counter the isolation of patches caused by forest fragmentation is that of habitat linkages, usually understood as linear corridors of habitat that physically connect larger habitat patches (Noss 1991). The primary function of these corridors is to facilitate the movement of animals between patches As shown in Figure 3-20, to move from patch A to D a species would use the corridor that connects them

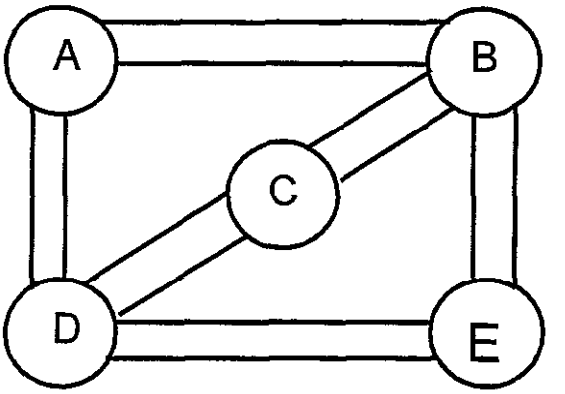


Figure 3-20. Landscape Linkages

As can be expected in a young science, the concept of corridors is controversial Noss (1991) felt that natural landscapes are fundamentally interconnected and that connectivity declines with human modification of the landscape Simberloff et al (1992) and Shafer (1990) raise serious questions about the lack of data supporting the use of corridors by wildlife. The biggest stumbling block is that very few studies have looked at animal movement without corridors (Simberloff et al 1992). Lindenmayer and Nix (1993) point out that there is a paucity of data on the effectiveness of corridors for nature conservation. Others (Shafer 1990, Hudson 1991, and Fielder and Jain 1992) say that there is a need for corridors, even if their usefulness has not been scientifically demonstrated

The counter strategy is to minimize the movement barriers between the patches (Thomas et al 1990, Noss 1991) Expanding on that strategy, Morrison et al (1992) pointed out that a generalized solution to linking patches within and across landscapes might be found in providing for a specific kind of matrix That is, providing specific vegetation types and cover conditions across the landscape that allow for the movement of species.

The authors further state that this matrix approach does not lock habitat into specific routes, and may allow for better resilience and recovery from loss of specific stands from catastrophic events As shown in Figure 3-21, under this strategy the area between the patches does not prevent movement, so that the species are not restricted to the corridors They could use any of the dark gray area to get from patch A to patch B to patch C

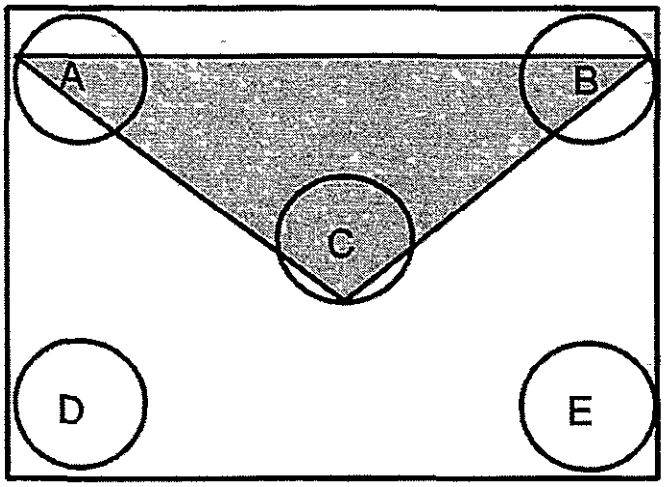


Figure 3-21. Corridor Movement Example

AFFECTED ENVIRONMENT

Before a discussion on fragmentation and connectivity can be undertaken, it is important that the current situation on the RGNF be put into context with respect to the amount of existing fragmentation, undeveloped landscapes, and late-successional forests

Existing Fragmentation

Only 2% of the forested cover type (26,540 acres of 1,167,420) has had clearcut/overstory-removal timber harvests in the last 30 - 50 years The reason only these two harvest methods are considered has to do with the fact that temporarily they convert a forested stand to an unforested condition, which might create a barrier to species movement

Figure 3-22 shows where these harvests have occurred on the Forest Appendix K contains a further discussion of the effects of the two harvest methods)

To put the 2% figure in perspective, Rosenberg and Raphael (1986) estimated that in roughly 30 years, nearly 50% of the mature and old-growth Douglas-fir forests in northwestern California were clearcut, with an even larger proportion cut over a longer period in western

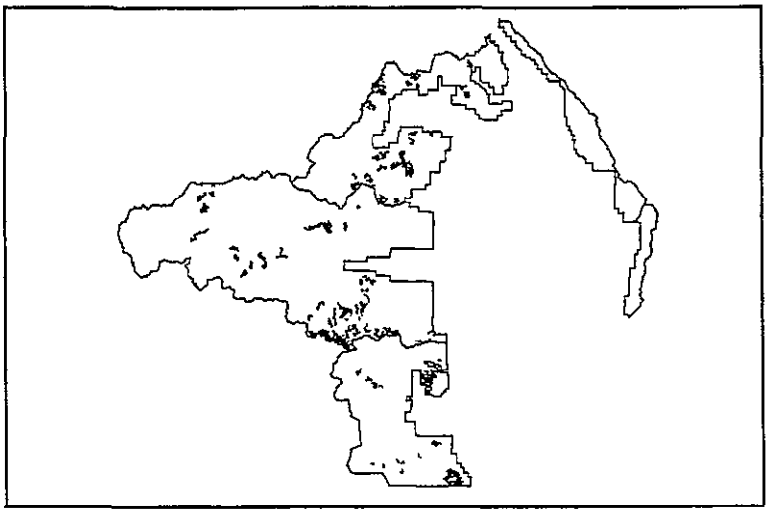


Figure 3-22. Final Harvest Sites on the RGNF

Oregon and Washington. The other types of timber harvesting leave behind forested structure

Undeveloped Landscapes

Land considered to be undeveloped (without roads) comprises 58% of the Forest (1,076,430 acres of 1, 856,760) (See Figure 3-23)

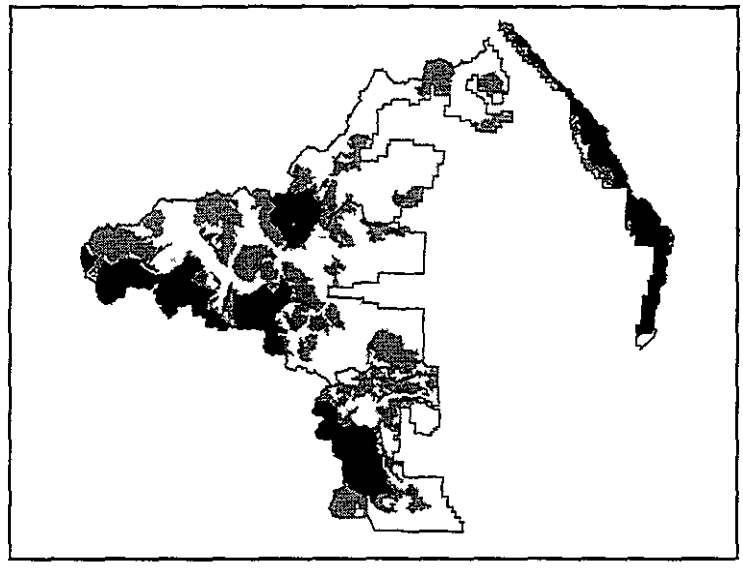


Figure 3-23. Wilderness, Roadless and Undeveloped lands on the RGNF

Late-Successional Forests

Of the RGNF's forested acres, 62% can be classified as late-successional forests (722,970 acres of 1,167,420) "Late successional" is defined as structural stages 4B (>9" DBH, 40-70% canopy cover), 4C (>9"DBH, >70% canopy cover), and 5 (softwoods >200 years-old, hardwoods >100-years old and 70% canopy cover) (Figure 3-24 shows where the late-successional stands are located on the Forest)

Of the late-successional forest, 61% is currently in an undeveloped state (439,380 acres of the 722,970)

There are two reasons for lumping the structural stages. First, there was a question as to the accuracy of the data It appeared that perhaps as much as half of the stands designated a "B" really should have been a "C," and vice versa

Second and more important, for those species considered to be associated with late-successional forests, their habitat attributes of tree diameter and canopy closure were common to all three structural stages. The species looked at were goshawk, lynx, marten, red-backed vole, three-toed woodpecker, boreal owl, golden-crowned kinglet, and

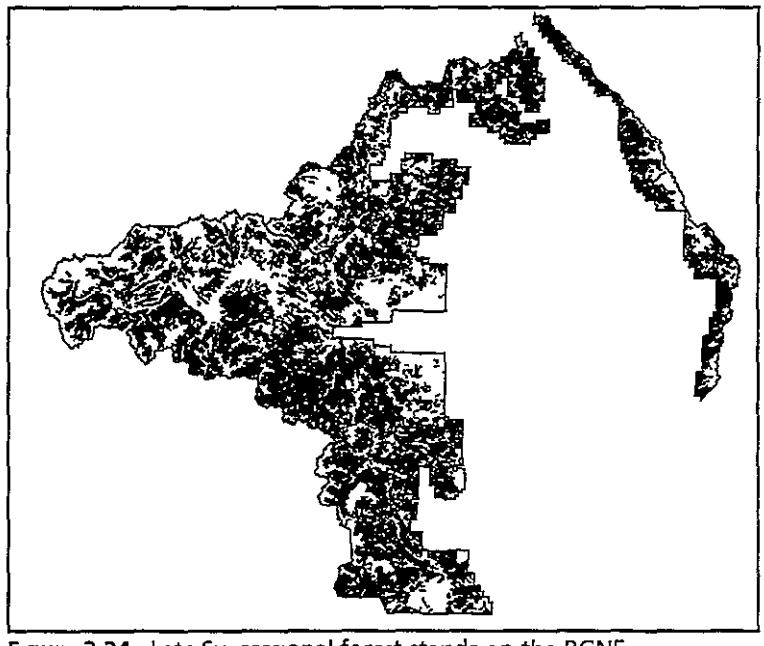


Figure 3-24. Late Successional forest stands on the RGNF

brown creeper One common thread was the need for large trees These trees would be represented within the three structural stages. (It should be noted that the RGNF does not have the capacity to grow trees that are large at maturity Generally, softwoods in the 16"-to-20"-diameter range and hardwoods in the 11"-to-13" range of maturity would be considered large for the Forest.)

The other attribute that characterizes structural stages is canopy cover The following values were found in the literature for canopy cover

Goshawk — Optimum habitat ranges from 40% to 70+% canopy cover, depending on the particular habitat component (Reynolds et al. 1991)

Marten — Optimum habitat is considered 30+% (Clark et al 1989, Fitzgerald et al 1994)

Red-backed vole· — Optimum habitat ranges from 46% (Crompton 1994) to 62% (Raphael 1989)

Boreal Owl· — Optimum roosting habitat is 44% (Hayward and Verner 1994)

golden-crowned kinglet and brown creeper — Optimum habitat ranges from 30% to 93%, with a mean of 55% to 60% (Carter and Gillihan pers communication).

This range of values falls within the lumped structural stages

Finally, for the forests of Colorado, Hoover and Wills (1984) attempted to rate the structural stages (by cover type) on how well they met the feeding and cover needs of species Where possible, they used the existing literature, if the literature was weak or nonexistent, they relied on the experience and expertise of biologists to develop the rating There were 44 combinations of cover type, structural stage, and feeding and cover ratings for goshawk, lynx, marten, red-backed vole, and three-toed woodpecker. In 37 (or 84%) of those combinations, the three structural stages had the same reading This implies that the three stages include similar habitat, and there is no need to differentiate them

Because the viability of larger species requires habitat beyond the RGNF boundary (see the TES section for further discussion), we looked for any potential corridors that link the Forest to surrounding areas We have no information that identifies any such corridors We felt the human population growth in the area has severely restricted the ability of larger species to use unforested habitat as corridors We took a conservative approach and said that any obvious narrowing or constriction of forested cover was a potential corridor No attempt was made to look for these constrictions by a particular cover type

In terms of species movement, no known studies show that a particular species requires a particular type of forest cover. In fact, it could be argued that the species that might use these types of corridors are those which have a larger home range—and, as such, have become adapted to many different cover types

To determine where these potential corridors might be, we used the forest-cover-type map that Powell et al (1993) included in a report on the United States forested resources for the

Resources Planning Act (RPA) The USFS Rocky Mountain Regional Office in Golden was able to supply the data for that portion of the map that covered the Tri-Section area.

Five areas were selected that had an obvious narrowing of forest cover and linked the RGNF to the surrounding area (Figure 3-25) Because of the coarse scale used for the RPA map, the constrictions we identified might not be as narrow as shown on the map These areas will be treated as if they are corridors needed for movement beyond the RGNF. These corridors are. (1) Cochetopa, (2) La Garita, (3) Spring Creek, (4) Bonito, and (5) Sangres. The names were chosen from nearby landmarks It should be noted that except for #4 Bonito, the narrowness of the forested cover type appears to be a natural phenomenon Bonito was chosen because of the previous clearcutting that occurred in the area in the 1950s and 1960s

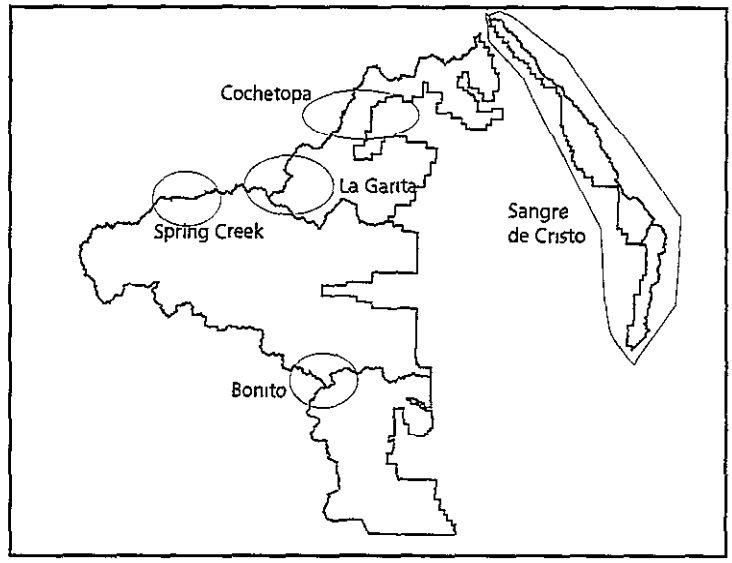


Figure 3-25 Corridors on the RGNF

For each area, the potential risk of rendering the area unsuitable as a corridor was assessed. Six criteria were used in the evaluation They were·

1 What is the predominate landownership around the area? (This was chosen because there is limited control over what happens on private lands)

2. What is the relative width of the area, compared to the other areas? (This was chosen because we felt narrower areas were more at risk from outside forces.)

3 What amount of recreational visitation does the area get? (This was chosen because human use may alter the behavior of certain wildlife species.)

4 What is the road density of the area? Like #3, this was chosen because of the potential disturbance of wildlife (This value was taken from the results of the "moving window" analysis explained in the discussion on motorized access/recreational impacts in the next section)

5. Are there any paved highways in the area? (This was chosen because some studies have shown that larger species might not cross heavily used roads In addition, paved roads can lead to an artificially high mortality rate for those species which try to cross them, since vehicles tend to travel faster than on dirt roads)

6 How much of the area contains lands identified as suitable for timber harvesting? This was chosen because timber harvesting could cause the corridor to lose its potential effectiveness

RESOURCE PROTECTION MEASURES

There is a guideline that begins the process of trying to approximate the vegetative composition and structure of reference landscapes (The details of the process can be found in Erhard et al 1996) Spatial analysis was conducted on 14 undeveloped landscapes The assumption was these reference areas represent the composition and structure expected in a "natural" setting.

The focal points of the analysis were the composition of vegetative structural classes and the patch-size distribution of late-successional forest The intent is to compare the proposed timber sale areas against these reference conditions, and plan timber sale activities in such a way as to begin to simulate the reference conditions

ENVIRONMENTAL CONSEQUENCES

Effects Common to All Alternatives

Fragmentation

The situation that has unfolded in the Northeast and Pacific Northwest, with the impacts from fragmentation and loss of connectivity, cannot be extrapolated to the RGNF today, or for the next 10 to 15 years, therefore, the impacts are considered insignificant The reasons are the small amount of fragmentation (existing and planned, by Alternative), the ample amount of undeveloped areas, and the abundance of late-successional forest on the RGNF

The specific consequences as they relate to the three fragmentation concerns of patch isolation, patch size, and edge effects are discussed below

Patch Isolation: The amount of clearcut and overstory-removal timber harvests planned can be seen in Figure 3-26 The results are that, regardless of budget level, there will be no detectable change in the current 2% of the Forest harvested by these methods This is well below the 50% threshold that Franklin and Forman (1987) found caused patches to start to lose their interconnectiveness and become isolated

Looking at Figures 3-22 and 3-26, two things become apparent First, given the scattered nature of the

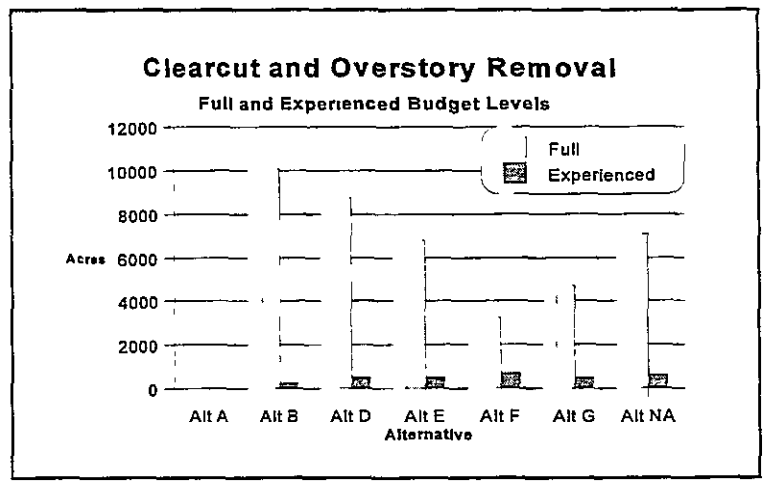


Figure 3-26 Acres of Clearcut and Overstory Removal in the first decade based on budget levels.

clearcutting and overstory-removal harvests to date and the small amount of acreage proposed, they would not alter the landscape in a major way, and species would be able to move around them Second, the late-successional forests are well distributed across the landscape, with no large gaps that might isolate patches The apparent gaps seen on the map are primarily caused by naturally unforested habitats (i e., alpine and rangelands)

Patch Size: Given the low percentage of area altered by timber harvesting, the extent of undeveloped areas, and the natural patchiness of the Forest (Figure 3-24), it is hard to see how there has been an alteration of the patch-size distribution The spatial-analysis guideline will minimize the potential for future human activities' changing the patch-size distribution

Franklin and Forman (1987) estimated that the average forest patch size remained unchanged until 30% of the area had been cut over In their study they addressed only clearcuts As mentioned above, the Forest would be way below that value Even if all the timber harvest were taken into account, the total would still be below the 30% value (142,100 acres harvested/1,167,420 acres forested = 15%)

At the 15% value, it could be argued that the last 100-hectare patch has been lost, since that is what Franklin and Forman found happened at that level in their study That is not the case here. As the authors noted, this occurred only when using the checkerboard model of harvesting, all other models retained large patches much further into the cutting cycle. And as demonstrated in Erhard et al (1996), there are large patches left in the reference areas—and, one could assume, in the rest of the undeveloped landscape on the RGNF.

Questions have been raised as to the validity of the concept that bigger patches are always better. Boecklen and Gotelli (1984) found that the species-area relationship and models of faunal and floral collapse are weak conservation principles, they have low explanatory power, are Sensitive to particular cases, and give unreliable estimates They felt that these models should be subordinate to other considerations, such as habitat heterogeneity, species identity, habitat requirements, and disturbance regimes

Schieck et al (1995) point out other studies, however, that have shown a strong relationship between the richness and abundance of forest birds and patch size Yet they did not find any relationship between (in this case) old-growth patch size and species richness or abundance They offered three plausible explanations (1) the populations within the small patches were maintained by immigration from the extensive old-growth areas surrounding the study site, (2) because of the natural heterogeneity of the landscape, species have evolved in such a way as to interact effectively with other species from the various habitat types; and (3) the contrast between the patches and the area between the patches was relatively low

The results that Schieck et al found are consistent with the two studies that have been conducted on the Forest One was in spruce-fir (Carter 1995) and the other in mixed-conifer (Gillihan and Carter 1996) Each of them looked at the relationship between habitat attributes (size, shape, and structural class) and bird species richness and abundance. The occurrence of only one species, mountain chickadee, could be explained by the larger patch size, but it also responded positively to the smallest patch size When species richness and abundance were considered, neither study found that the largest patches had significantly higher values From a purely numeric value, the highest values were in the smallest patches.

The most important attribute was structural class, and it is discussed in more detail in the Wildlife section

Edge Effects: Besides the two Forest studies mentioned above (Carter 1995 and Gillihan and Carter 1996a), we found two others that were done in the Region (Keller and Anderson 1992 and Crompton 1994) and looked at possible influences of edge on bird distribution and occurrence None of the studies found an avoidance of edge, per se, by any species Carter found that Cassin's finches avoided patches with the largest amount of edge (but not those with intermediate amounts of edge), and Golden-crowned kinglets preferred those patches with an intermediate amount of edge Generally, if there was a response to edge, it was positive

Both Carter and Gillihan and Carter were able to conduct part of their study near roads (primarily dirt roads <20 feet wide), and in each case they did not find a shift of species abundance within 300 feet of the road This suggests that for birds, there was no negative response to the edges created by the roads

Crompton also looked at edge influence on small mammals, and found no avoidance of edge

This apparent lack of response to edge suggests there might not be any forest-interior species on the RGNF This makes intuitive sense when one considers that a feature of subalpine (spruce-fir) forests in the Rocky Mountains is their discontinuous or patchy distribution (Knight 1994) Both Carter (1995) and Gillihan and Carter (1996a) make note of the highly patchy nature of the forest in their study areas.

A good illustration of this natural patchiness can be seen in Figure 3-27 These data were collected from the 14 unroaded areas used as reference landscapes (see Erhard et al 1996 for more details). They show that on a percentage basis, the majority of the patches are 180 acres or less in size The preponderance of patches in the smaller size category means there would have been plenty of edge occurring naturally The implication is that species on the Forest have adapted to the presence of edge

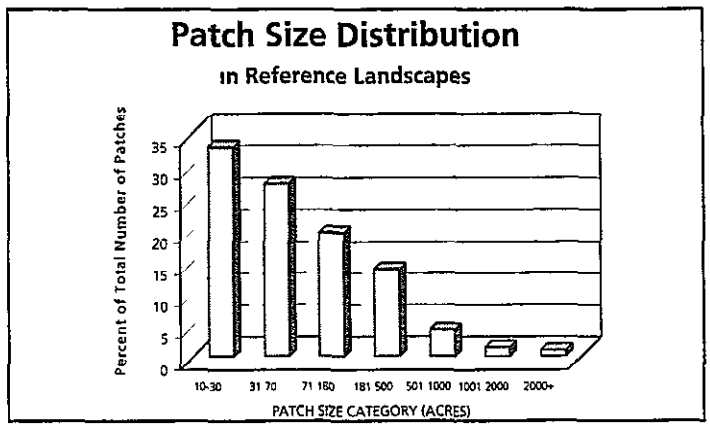


Figure 3-27. Patch Size Distribution in Reference Landscapes

This thought was echoed by Reese and Ratti (1988), who suggested that since Western montane forests may be naturally more diverse and fragmented and have more inherent edge than Eastern forests, species adapted to Western forests may not experience the negative aspects of fragmentation as severely as those in Eastern forests Given the large amount of natural edges, the results of the studies, and the fact that the majority of created edges will be of low contrast (most stands entered by the dominate harvest methods will

remain moderately dense), the adverse impacts from the creation of edge habitat will probably be low

Increased nest predation and parasitism are a concern within the edge habitat One of the difficulties is defining just what constitutes edge. Chen et al (1992) looked at clearcuts in Oregon and found that, depending on the vegetative parameter, the depth-of-edge effect ranged from 16-137 meters Paton (1994), in reviewing numerous edge studies, found that researchers often use relatively arbitrary habitat characteristics to define edge He recommends, based on the silvicultural literature, that when looking at the juxtaposition between forested and unforested habitat, only openings greater than three or more tree heights be considered edge Only one study was found that made an attempt to quantify edge habitat between two forested stands. Crompton (1994) looked at some partial cutting in the Black Hills and found no dramatic difference in vegetative variables between his treated and untreated plots.

For edges created between forested and unforested habitat, Paton (1994) concluded that the current evidence, although equivocal, suggests that predation and parasitism rates are often significantly greater within 50 meters of an edge Rudnicky and Hunter (1993), however, found no evidence suggesting a distance-to-edge effect for predation rates on ground nests, although shrub nests were preyed on with greater intensity along the clearcut-forest edge There are a couple of problems with trying to extrapolate these results to the RGNF they are from the Eastern part of the country, and they deal with forested versus unforested situations.

We found only one study that looked at partial cutting and was in the Western states Reese and Ratti (1988) found that there was less predation in the "feathered edge" of a shelterwood harvest than in the abrupt clearcut edge They surmise that predation rates may be high in early successional stages and then decline as vegetative complexity increases with age, reducing the edge contrast

Recently there have been questions raised about the edge effects on predation. Haskell (1995) presented data which did not support the trends reported by quail-egg experiments, which is what most other studies have used One of the problems is that quail eggs are too large for the potential small-mouthed predators Using clay eggs, he found no difference in the rate of predation between patches of differing sizes. In the larger patch sizes, there was a shift in predators from corvids (crows and blue jays) to rodents (chipmunks and mice) With so much of the RGNF remaining under the influence of natural processes and the majority of the timber harvesting leaving low edge contrast, there should be little overall increase in nest predation from human-caused activity

Increased nest parasitism by brown-headed cowbirds in forest fragments has been found in the Eastern states Andrews and Righter (1992) report that cowbird eggs have been found in the nests of 38 different bird species in Colorado Cowbird parasitism is not a major concern for those birds within the forested landscape, because there are so few of them Out of 1,089 point counts, Carter (1995) found them on only 3 points and Gillihan and Carter (1996a) found them on 33 of 1,002 point counts

As shown in Figure 3-28, regardless of budget level, the amount of undeveloped areas (areas without roads) entered would be small Consequently, almost two-thirds of the Forest would remain in an undeveloped condition and at a low risk of alteration by human disturbances

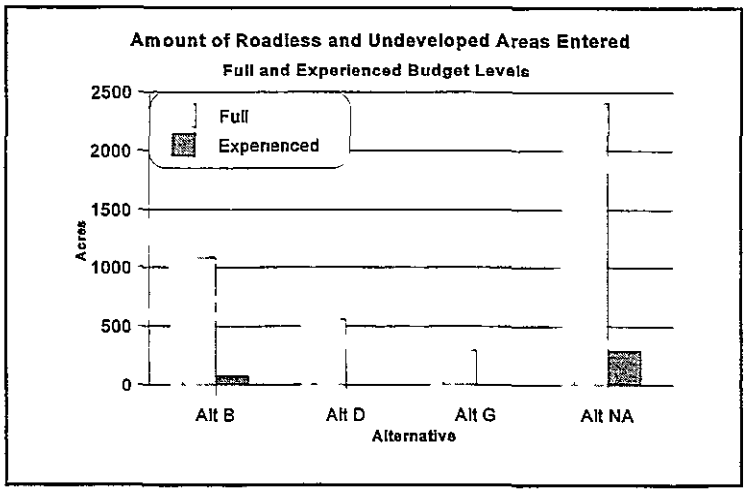


Figure 3-28. *Amount of unroaded areas entered in first decade*

Figure 3-29 shows the reduction in the amount of late-successional forest as a result of harvesting by Alternative and budget level It needs to be pointed out that harvesting in and of itself might not result in a loss of the structural characteristics associated with late-successional forests This is especially true for the uneven-aged harvests Consequently, almost two-thirds of the RGNF's forested acres would remain in a late-successional condition.

As stated in Harris and Silva-Lopez (1992), although timber harvests are ecologically very different from natural gap-forming processes, timber cuts can be made to approximate natural gaps as long as the individual cuts are small relative to the total expanse of forest, and the total acreage of cut over forest does not exceed 50% of the total forest acreage This fits the situation on the RGNF under all Alternatives

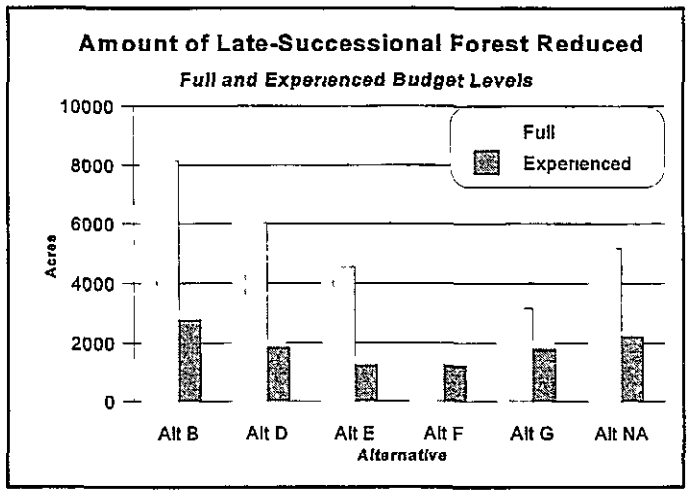


Figure 3-29. Amount of Late-successional forest reduced in the first decade

For this discussion, road fragmentation will be discussed in the context of roads as barriers to movement This is not to suggest that roads do not impact wildlife-use patterns While it is obvious a species might not use habitats near a road very often, this is not the same as saying the species would not cross that road The Threatened, Endangered, and Sensitive Animals/Viability section discusses the potential impact roads have on habitat use and species displacement For the larger species, the one road that might receive enough traffic to impede movement is U.S 160, the major east-west route through the San Luis Valley In the past few years it has been widened in places, especially the portions between Wolf Creek Pass and South Fork Even with the improvements, there are many times when very little traffic is on the road, especially in the

winter and spring. This fact, combined with numerous sightings of animals crossing the road, suggests that it has not become a complete barrier yet There are no data available to tell if there has been any decrease in crossings

Oxley et al (1974) found that in Quebec several types of small mammals rarely ventured onto road surfaces when the road clearance exceeded 20 meters Medium-sized mammals (skunks, marmots, porcupines) would cross paved roads 30 meters wide Many sections of paved highways near the RGNF, and some Forest roads, approach or exceed these widths Swihart and Slade (1984) found that in Kansas very few voles and rats ever crossed a dirt track three meters wide In another Kansas study, however, Kozel and Fleharty (1979) found some small mammals that would cross Interstate 70 (almost 75 meters wide) after being taken across it

With the differing results and the fact that they are in habitats unlike those found on the RGNF, it is hard to tell if there are indeed small-mammal barriers on the Forest It would appear that the wider roads on the Forest might be considered at least inhibitors of movement. This could eventually lead to some problems for the small mammals on the Forest But the potential impact is somewhat offset by the following factors·

* The majority of RGNF roads are classified as 2-tracks with narrow road beds (2-4 meters), and are usually partially vegetated This should facilitate movement across them

* Fifty-eight percent of the Forest is not roaded This, combined with the previous point, means that there would be large acreages between the roads that might be inhibitors to movement And because small mammals have small home ranges, there should be plenty of potential habitat to sustain a population

* In the absence of complete barriers, some small mammals would be crossing the roads occasionally. This would be enough to maintain genetic variation of the populations (Howe 1990)

The Alternatives incorporate the two strategies described earlier, in the Connectivity section, to counteract the small amount of risk in the event there is more patch isolation than anticipated

Except for Alternative F, the other Alternatives incorporate the landscape-matrix strategy This strategy would be accomplished by ensuring that timber harvesting follows the spatial guidelines described under Resource Protection Measures The intent is to approximate landscapes that best represent "natural" conditions, based on the assumption that the "natural" composition and structure of a landscape provide a suitable matrix for wildlife-species dispersal.

Alternative F uses the corridor strategy. In addition, the spatial guideline would still apply to any timber harvesting Since there is limited timber harvesting under this Alternative, the corridor strategy has the overriding influence.

At present, there is no way to evaluate which strategy would work best in this area. The discussion has to be in the context that there is no reason to expect any large-scale loss of connectivity on the RGNF. This, then, renders the discussion more of an academic exercise. To address the question properly, the target wildlife species would have to be known, along

with its home range, habitat requirements, dispersal distance, and dispersal habits (e g , random or in a predictable pattern). Until these questions are answered, we can only hypothesize which strategy would work best

Connectivity beyond the RGNF

Table 3-24 shows how the five corridors compare with the six criteria

There are two values given for the two criteria of visits and road density The first value represents the situation that occurs during big-game hunting season. The second is for the other times of the year.

Table 3-24. Comparison of Corridors to Corridor Criteria

CRITERIA	CORRIDORS				
	COCHETOPA	LA GARITA	SPRING CREEK	BONITO	SANGRES
Land Ownership	Public	Public	Public	Public	Public
Width	Med	Wide	Wide	Med	Narrow
Paved Road	Y	N	Y	N	N
Visits[1]	High/Low	Low/Low	Low/Low	High/Low	Low/Low
Road Density[2]	High/Med	Low/Low	Med/Low	High/Low	Low/Low
Suitable Timber [3]					
ALT A	None	None	None	None	None
ALT B	50%	0%	60%	90%	<1%
ALT D	50%	0%	60%	90%	<1%
ALT E	50%	0%	0%	50%	<1%
ALT F	0%	0%	5%	50%	<1%
ALT G	40%	5%	60%	90%	<1%
ALT NA	5%	15%	50%	10%	<1%

1 The first value refers to the big game hunting season, generally mid-October to mid-November, second value is for rest of the year
2 The first value refers to all motorized routes Second value refers to primary roads See discussion under Management Indicators for more explanation
3 refers to the relative amount of each area that contains lands identified as suitable for timber harvesting This does not mean that they would be harvested in this planning period

Regardless of Alternative chosen, none of these areas would become barriers to species movement, although during hunting season two of them (Cochetopa and Bonito) could receive enough use to hinder species movement temporarily A summary of these findings

* Even if there is timber harvest activities, the forested character will remain as a result of the spatial guideline for timber harvesting

* The low levels of visits and road density would result in limited impacts on potential species movement During hunting season, the high use could temporarily hinder the

movement of species through the area The Saguache Ranger District is currently analyzing the area around Cochetopa to see which roads should be restricted from motorized use.

* Having each area in public ownership offers a certain degree of protection from intensive development and helps to retain the character of the landscape

* The paved roads in two of the potential corridors run parallel to the potential corridor, which means the species do not necessarily have to cross them to use the corridor. In addition, they are state highways that receive relatively light use, compared to other highways in the San Luis Valley

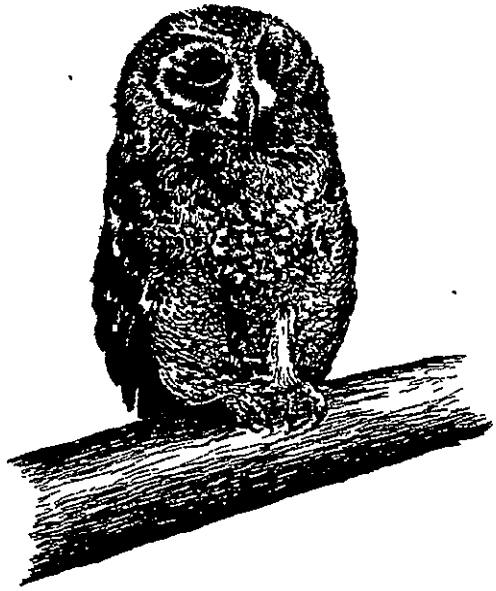
CUMULATIVE EFFECTS

No Alternative will create a landscape of remnant habitat patches surrounded by habitats that would preclude species from traveling between the patches, because

* As a result of not appreciably changing the acreage of either the undeveloped land or the late-successional forest, the RGNF will maintain its characteristic patches of human disturbances surrounded by a landscape of late-successional forests

* There will be no large-scale loss of connectivity between patches within the RGNF, because of the limited amount of clearcutting or overstory-removal timber harvesting

No Alternative will alter any of the five potential corridors enough to preclude species movement beyond the RGNF, although during hunting season there could be enough use to impede species movement temporarily



Threatened, Endangered, and Sensitive Animals / Viability

ABSTRACT

Two important laws govern our management of wildlife habitat. One is the *Endangered Species Act* (ESA) and the other is the *National Forest Management Act* (NFMA). The ESA requires us to manage habitat in such a way as to not jeopardize those species listed as Threatened or Endangered (T&E). The implementing regulations (1982) require us to manage habitat in a way that maintains viable populations of species.

Two T&E species are known to occur on the Forest, American peregrine falcon and bald eagle. Potential habitat may exist for four other T&E species (grizzly bear, Mexican spotted owl, southwestern willow flycatcher, and Uncompahgre fritillary butterfly), but their presence has not been verified.

In addition, there is a list of Sensitive species for the Forest Service's Rocky Mountain Region. These are species are of concern because of a suspected downward trend in their population, and/or their habitat is being lost. There are three amphibians, one fish, fifteen birds, and five mammals considered Sensitive that are known or suspected to occur on the Forest.

Determining species viability is a very complex and difficult procedure. Some work has been done to try to define the number of individuals needed to secure a viable population. There is no single value or "magic number," however, that has universal validity. It can be said that, except for some very immobile or small species, such an assessment must consider an area larger than the RGNF.

Our assessment will employ a process that provides habitat for subpopulations which allows for their survival, and also interaction between the subpopulations.

To evaluate the impacts of the Alternatives, Landtype Associations were chosen as management indicators because they are the basic ecological unit that contains wildlife habitat. Four parameters were used to assess habitat suitability:

1. structural-class composition,
2. percentage in an undeveloped condition,
3. density of open roads, and
4. spatial patterns.

None of the Alternatives will appreciably change the four parameter values from what they are currently. As a result, there will be limited impacts on the T&E and Sensitive species, and the risk to species viability is considered small.

INTRODUCTION

Legal Framework

Many laws and regulations govern the management of wildlife habitat. Of these, the two most important are the *Endangered Species Act* (ESA) and the *National Forest Management Act* (NFMA) and its associated implementing regulations. The ESA requires us to manage habitat so as to not jeopardize those species listed as Threatened or Endangered. The NFMA regulations require us to manage the habitat in a way that maintains viable populations of species.

Threatened or Endangered Species

The *Endangered Species Act of 1973* requires all federal agencies to conserve Threatened or Endangered (T&E) species and their habitats. "Endangered" means the species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means the species is likely to become Endangered species within the foreseeable future throughout all or a significant portion of its range.

The U.S. Fish and Wildlife Service (USFWS) decides which species get placed on the T&E list. Once a species is listed, a Recovery Plan is developed, detailing the conditions necessary for a species to become "de-listed." The completion of a Recovery Plan depends on budgets and priorities, and can take years from the time a species is listed. The conditions might include the number of pairs successful in raising young, or the number of young per pair.

An integral part of any Recovery Plan is the designation of "critical habitat." This is habitat the USFWS feels is essential for the species to recover, and it must remain suitable for the species. In terms of the required level of protection, the difference between Threatened and Endangered is not distinct. For that reason, the species are lumped together and called T&E.

The Forest Service is responsible for managing the habitat for T&E species; we do not initiate any transplants or reintroductions of T&E species. That is the responsibility of the USFWS.

AFFECTED ENVIRONMENT

Two T&E species are known to occur on the Forest, American peregrine falcon and bald eagle. Potential habitat may exist for four other T&E species (grizzly bear, Mexican spotted owl, southwestern willow flycatcher, and Uncompahgre fritillary butterfly), but their presence has not been verified.

BIRDS

Peregrine falcons are closely tied to the availability of cliffs, which they use for nesting. The falcons prey primarily on other birds, so generally they live near areas that support high bird

numbers, such as riparian areas The Falcon Recovery Plan did not designate any critical habitat on the Forest There are three known peregrine nests on the Forest, however, and each of them has been active the past few years

Bald eagles are winter residents of the San Luis Valley and the Forest During the winter they roost in large trees with open canopies, usually near rivers and lakes They feed on a variety of items, with scavenging on dead animals being the primary method It is estimated that 10-15 eagles spend part of the winter on the Forest The Eagle Recovery Plan did not designate any critical habitat on the Forest Sightings of bald eagles have increased in the last several years

Based on survey work done in Colorado, the habitat preference of the Mexican spotted owl is steep-walled canyons in ponderosa pine and pinyon-juniper habitats In 1989 a response from a Mexican spotted owl was heard in the Alamosa Canyon area by a Rocky Mountain Research Station crew, which was trying to find out the distribution of the owl in Colorado From 1990 to 1993, this area was surveyed by Forest crews, with no further responses heard From 1990 to 1994, there was a Forestwide effort to locate the owls, with no success The Owl Recovery Plan did not designate any critical habitat on the Forest

The southwestern willow flycatcher is a subspecies of the willow flycatcher The existence of the subspecies in Colorado is unknown Two inventory efforts were undertaken in southwestern Colorado in the summer of 1994 There were no confirmed southwestern subspecies located While there are willow flycatchers on the RGNF, there is no good way of distinguishing the various subspecies

The habitat of known southwestern flycatcher pairs consists of dense multistoried riparian vegetation It was once thought that the birds needed a willow/cottonwood overstory, however, they have been found without the overstory trees It now appears that the most important attribute is the denseness of vegetation Another early hypothesis was that the birds were not found above 7,000' feet elevation This was nullified when birds were seen at 9,000' feet in New Mexico The one consistent habitat attribute is riparian width No birds have been found when the riparian area was less than 2-3 trees wide Due to the small number of known birds and the variance in habitats, there are no qualitative data to describe the habitat

MAMMALS

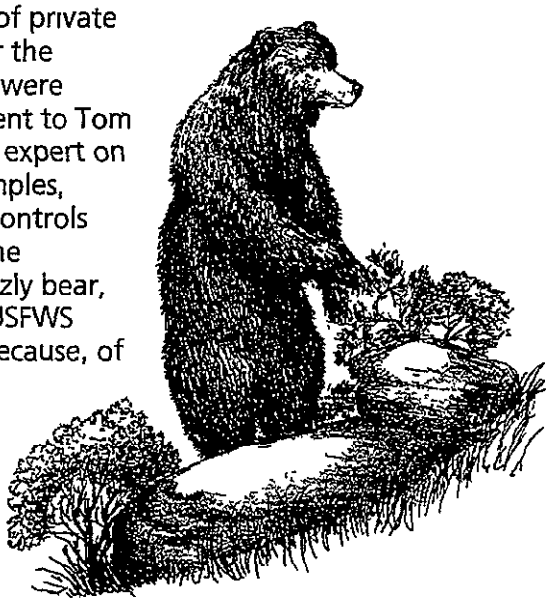
Grizzly bears are found in many different types of habitat The primary factor determining where bears are found relates to the amount of human disturbance Bears are generally intolerant of human disturbance and will avoid areas of concentrated human use The exception is where bears associate easy meals with human use, such as campgrounds and garbage dumpsters

The determination of the existence of the grizzly bear on the Forest is problematic A female grizzly bear was killed by an outfitter-guide in 1979, near Blue Lake in the South San Juan Wilderness This prompted a cooperative study in the early 1980s by the Forest and

the Colorado Division of Wildlife (DOW) to locate additional grizzlies Those efforts failed to produce any evidence of grizzly

In the summer of 1990, a scientist from the Humane Society of the United States searched the Wolf Creek Pass area for evidence of grizzlies Although he was unsuccessful, he reported that four people, including an outfitter, had claimed to see grizzlies, tracks, or other signs in the San Juan Mountains.

Another attempt was made in 1991 by a group of private individuals known as the Citizens Committee for the Colorado Grizzly They found hair samples that were believed to be grizzly bear The samples were sent to Tom Moore of the Wyoming Fish and Game, a noted expert on hair identification Along with the collected samples, three known grizzly bear samples were sent as controls The results from the analysis were that two of the samples were identified as similar to known grizzly bear, and five were either grizzly or black bear The USFWS did not consider the results as definitive proof because, of the three known grizzly bear samples sent, two of them could not be positively identified as grizzly bear The Citizens Committee is now known as the Round River Conservation Studies, and they have been conducting field trips over the past few years collecting habitat data and pursuing evidence of grizzly bears They have been attempting to find a facility to conduct DNA testing



The USFWS has added the San Juan Mountains to the Grizzly Bear Recovery Plan as an area to be evaluated in terms of habitat suitability and the potential population that it could support. According to the Service, evaluation of the area is a low priority, since the existence of bears is questionable and funding is limited Consequently, there is no set timetable to begin the evaluation process

Though the wolf no longer inhabits the Forest, a preliminary study done for the USFWS concluded that there is suitable habitat to support it (Bennett 1994) The report considered the following items for each of the "potential wolf recovery areas" (1) gross land area, (2) percent of public land, (3) amount of Wilderness, (4) proportion of Wilderness to public-land area, (5) availability of deer and elk, (6) human density, (7) road density, (8) livestock density, (9) recreation use, and (10) snowpack limitations

The author rated each item as either Good (probably more than acceptable for reintroduction), Satisfactory (probably acceptable for reintroduction) or Unsatisfactory (probably not acceptable for reintroduction) Road density and recreation use were not rated, either because of insufficient data on wolf requirements or other reasons. For the RGNF "potential wolf recovery area," the author rated item #5 as Satisfactory, and the rest as Good According to the report, the Forest could support up to 89 wolves, with the probable number ranging from 40-80

A follow-up study assessed the public's support for reintroduction of the wolf. The results showed the public generally supports the idea: nearly 71% said they would vote for reintroducing wolves More east-slope residents (74%) than west-slope residents (65%) supported wolf reintroduction However, most of the people in both regions supported the idea (Manfredo et al 1994)

Because of these two studies, the USFWS has indicated that when the Rocky Mountain Wolf Recovery Plan is updated, the recovery team will be asked to evaluate the potential of including Colorado

INSECTS

The Uncompahgre fritillary butterfly is a small butterfly (one-inch wingspan) that inhabits the alpine It is associated with snow willow (*Salix nivalis*) above 12,000 feet, which provides larval food and cover. To date only three colonies have been discovered, all of them north of the Forest, in Hinsdale County

Sensitive Species

In March of 1993, the Regional Forester published a list of Sensitive species for the Rocky Mountain Region These species are of concern because of a suspected downward trend in their population and/or their habitat is being lost. The designation serves as an alert to avoid actions that would result in a species' placement on the Threatened or Endangered list

AFFECTED ENVIRONMENT

The following list details the Sensitive species known, or suspected, to occur on the Forest There are three amphibians, one fish, fifteen birds, and five mammals Unless otherwise noted, each species is known to occur on the Forest

Boreal Toad (*Bufo boreas boreas*)

Northern Leopard Frog (*Rana pipiens*)—No known recent locations on the Forest

Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*)

Tiger Salamander (*Ambystoma tigrinum*)

Black Swift (*Cypseloides niger*)

Boreal Owl (*Aegolius funereus*)

Burrowing Owl (*Athene cunicularia*)—No known records on the Forest

Ferruginous Hawk (*Buteo regalis*)—No known records on the Forest

Flammulated Owl (*Otus flammeolus*)

Fox Sparrow (*Passerella iliaca*)

Golden-crowned Kinglet (*Regulus satrapa*)

Goshawk (*Accipter gentilis*)

Lewis's Woodpecker (*Melanerpes lewis*)

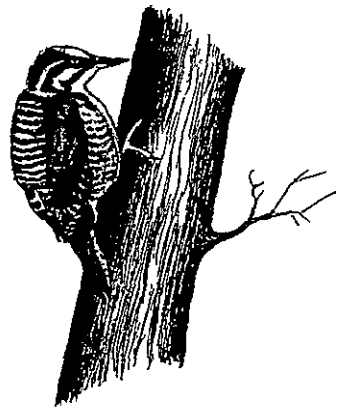
Loggerhead Shrike (*Lanius ludovicianus*)

Olive-sided Flycatcher (*Contopus borealis*)

Pygmy Nuthatch (*Sitta pygmaea*)

Osprey (*Pandion haliaetus*)

Three-toed Woodpecker (*Picoides tridactylus*)



White-faced Ibis (*Plegadis chihi*)—No record of them occurring on the Forest, but they are known to occur just outside the Forest Boundary

Dwarf Shrew (*Sorex nanus*)—No known records from the Forest

Marten (*Martes americana*)

North American Lynx (*Felis lynx canadensis*)—No recent records on the Forest

North American Wolverine (*Gulo gulo luscus*)—No recent records on the Forest

Townsend's Big-eared Bat (*Plecotus townsendii*)

Species Viability

INTRODUCTION

A major tenet in the NFMA implementing regulations is the idea of species viability. The charge is to manage habitats to maintain viable populations of all existing native and desired fish and wildlife species. A "viable population" has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range in the planning area The "planning area" is defined as one or more identified National Forest(s)

Unfortunately, there is little quantitative support or guidance for such viability assessments Soule (1987) recognized the dilemma of where to begin, and felt that looking at "keystone species", or those that reflect the limiting factors in ecological systems, was a good first

step It seems reasonable, then, to concentrate our efforts for determining viability on the Sensitive species, since those are the ones suspected of having a problem with population size or habitat distribution The T&E species were not used because two known species' habitat needs are very specific, and are better addressed at a smaller scale

Some work has been done to try to define the number of individuals needed to secure a viable population There is no single value or "magic number," however, that has universal validity (Soule 1987) Soule took an intuitive stab at a value for a vertebrate population and came up with a value in the low thousands. The point here is not the number per se, but to demonstrate that, except for some very immobile or small species, the assessment must consider an area larger than the RGNF

Many authors feel that in the absence of a quantitative method for determining viable-population sizes, a good hedge against extinction is to provide habitat for subpopulations that allows for their survival, and also for interaction between the subpopulations (Soule 1987, Morrison et al 1992, and Reiman et al. 1993) Our assessment uses this same line of thinking

This process is based on the concept of metapopulations or subpopulations Metapopulations are typically conceived as pockets or subpopulations that interchange genetic material (Morrison et al. 1992) These subpopulations are usually tied to patches of suitable habitat The idea is that as subpopulations become locally extinct from these habitat patches, they are recolonized with individuals from the other subpopulations (Morrison et al 1992). Theoretically, the diversity of local populations (i e subpopulations) in variable environments conveys stability to the larger metapopulation (Reiman et al 1993)

An equally important tenet is the need for the subpopulations to interact Wright and Hubbell (1983) found that the key to whether one large preserve was better than two small reserves was dependant on immigration As long as there was immigration, the difference in strategies was negligible

AFFECTED ENVIRONMENT

To figure out the amount of potential habitat for each suspected or known Sensitive species, a literature search was conducted The literature list included Bailey and Neidach, 1965; Hoover and Wills, 1984, Hammerson, 1986, Clark et al , 1989, Andrews and Righter, 1992, Finch, 1992, Fitzgerald et al 1994, Hayward and Verner, 1994, and Ruggiero et al , 1994

The described habitat requirements were then translated into a Landtype Association (LTA) and structural class LTAs were chosen instead of cover types for two reasons First, they are an attempt to define a basic biological unit (see the LTA section) Second, they better capture the juxtaposition of cover types a particular species would likely use For instance, boreal owls use aspen stands, but primarily only within the spruce-fir zone If we were to look only at aspen stands and call them potential habitat, we include them in the ponderosa pine zone, which boreal owls are unlikely to use.

An example of the process is as follows From the literature, marten habitat preferences were described as moist, late-successional coniferous forests. These preferences were best found in the Spruce and Douglas-fir LTAs, since they are both mesic-forest types. The late-successional component corresponds to Structural Class 5. The result is that 651,570 acres meet these conditions and will be considered as potential habitat for our analysis. This does not imply that all these acres are indeed habitat, or that these acres would result in a specific population number

Table 3-25 shows the LTA relationship by the preferred structural classes and the acres of potential habitat for the Sensitive species As can be seen, late-successional forests play an important role in providing habitat for those Sensitive species associated with forested LTAs Maps in Appendix F show how the potential habitat is distributed across the Forest.

The habitat requirements for three species--black swift, Townsend's big-eared bat, and dwarf shrew--are not associated with any particular LTA or structural class

The osprey's potential-habitat acreage reflects the amount of lakes we have on the Forest

The acres shown for wolverine include acres in the Forest's undeveloped areas.

For the boreal owl, flammulated owl, Lewis' woodpecker, pygmy nuthatch, olive-sided flycatcher, and three-toed woodpecker, the primary attribute that they are tied to is the presence of snags (standing dead trees). The chosen structure classes have the highest likelihood of containing the necessary sizes and amounts of snags

Snags are used by a great variety of species, for nesting, denning, perching, roosting, feeding, and cover There are two broad categories of snag users One is primary cavity nesters These are animals that excavate the initial cavity (hole) in the snag Woodpeckers and flickers fall into this group The other group is known as secondary cavity nesters These animals rely on the cavities from the former group, since they rarely make their own Some common species in this group are western bluebird, house wren, saw-whet owl, and squirrel

Hoover and Wills (1984) calculated the number of snags needed for three potential population levels of primary cavity nesters (100%, 70%, and 40%). The average number of snags per acre was 1.3, 0.93, and 0.53, respectively. Balda (1975) recommended a snag density of 2 2 per acre for secondary cavity nesters He felt a minimum density would be 1 7 per acre.

About one-third of the forested cover type has been inventoried (using RMRIS) to gather timber stand data One of the attributes collected was number of snags. Because of the structure of the inventories, they are biased toward stands that have had some level of timber harvesting. The average density of snags in these areas is 0.8 per acre The two bird studies discussed previously were conducted in areas that had no RMRIS data, and give an idea of what kinds of densities the other parts of the Forest have Carter (1995) found an average of 31 snags per acre in spruce-fir, and Gillihan and Carter (1996a) found an average of eight snags per acre in mixed-conifer The studies counted snags that were eight inches or greater in diameter It was felt that a cavity could not be built in a smaller tree (the snags in the RMRIS inventory had to be at least nine inches in diameter)

Table 3-25 Preferred Structure Class (in parentheses) by LTA and Acres of Potential Habitat

SPECIES	LANDTYPE ASSOCIATION						POTENTIAL HABITAT
	Spruce/ Fir	Willow Sedge	Ponderosa Pine	Douglas-Fir	Aspen	Western Wheat	
Boreal Toad		X					129,400[1]
Leopard Frog		X					129,400
Tiger Salamander		X					129,400
Rio Grande Cutthroat		X					129,400
Boreal Owl	X(5)						580,190
Burrowing Owl						X	24,790
Ferruginous Hawk						X	24,790
Flammulated Owl			X(5)	X(5)			81,760
Fox Sparrow		X					129,400
Golden-Crowned Kinglet	X(5)						580,190
Goshawk	X(5)		X(5)	X(5)	X(5)		677,290
Lewis' Woodpecker		X	X(4&5)				172,460
Loggerhead Shrike						X	24,790
Olive-sided Flycatcher	X(4&5)			X(4&5)	X(4&5)		753,610
Osprey		X					1,220[2]
Pygmy Nuthatch			X(4&5)				43,060
Three-Toed Woodpecker	X(4&5)			X(4&5)	X(4&5)		753,610
White-Faced Ibis		X					129,400
Marten	X(5)			X(5)	X(5)		651,570
Lynx	X (1&5)						676,070
Wolverine							1,076,430[3]

1 Reflects total acres of known riparian area
2 Reflects acres of lakes
3 Reflects acres of undeveloped areas

Potential Habitat

Management Indicators

According to 36 CFR 219.19 (1), management indicator species shall be identified to estimate the effects of the Alternatives. There is wide latitude given in selecting the particular indicators The *Rocky Mountain Regional Guide* also gives some direction for the selection of the indicators

When originally set up, the focus was on selecting particular fish and wildlife species The premise was that the population changes of these indicators were believed to signify the effects of management activities on other species as well This concept has come under increasing scrutiny, and is highly questionable (Landres et al. 1988, Laudenslayer 1992). In addition, it required a knowledge of population size and trend that the Forest Service did not have the time or money to gather.

The other concern that has surfaced about selecting particular fish and wildlife species is that many of them spend portions of their lives off the Forest Consequently, any changes in their numbers could very well be caused by something that has occurred off the Forest For example, neotropical migrant birds face a multitude of impacts south of the Mexican border that have nothing to do with how a particular Forest is managed.

For this reason, it is logical to concentrate on plant communities as management indicators Under the CFR, it is permissible to select plant species, and the *Regional Guide* speaks to plant communities

The benefits of using plants communities are many Some of the more obvious are

* As shown in Table 3-25, many of the Sensitive species can be linked to a LTA
* Plant communities are the basic biological unit from which species derive their habitats.
* A fundamental principle of ecology is that without any habitat, there would be no species
* Compositional and structural changes in the plant community can be noted quickly.
* When conditions change in the plant communities, we can make inferences as to their suitability for various species
* The Forest has control over how the plant communities are managed, and therefore, any changes are the responsibility of the Forest.
* We know more about the location, extent, and conditions of our plant communities than about population sizes and trends for the fish and wildlife species on the Forest

For this analysis, LTAs will be considered the management indicators and used in comparing the Alternatives As Wilcove (1991) pointed out, while there are good reasons to monitor habitats, there is still a need to monitor species. We realize that the indicators chosen are

best for coarse-filter elements To fill that gap, a number of species have been included in the monitoring plan with the intent of tracking their occurrence and population. We felt these species were the ones most likely needing a fine-filter approach

Three quantitative parameters will be used to assess the habitat suitability for a particular species or group of species

* *the structural-class composition,*
* the percentage of area in an undeveloped condition (i.e , Wilderness and roadless areas), and
* the density of roads

In addition, cover-type patterns and quantity will also be used for the suitability analysis

Structural class composition is useful because it can be used to track the relative age of the forest This is important because wildlife species respond differently to the forest as it ages. One issue of high public interest is late-successional forest, both its location and amount We will be able to answer those questions by following the changes in structural classes.

Table 3-26. Current Structure Class Distribution

LANDTYPE ASSOCIATION [1]	PERCENT % BY STRUCTURE CLASS				
	1	2	3	4	5 [2]
1 (Spruce/ fir)	10	5	15	9	61
2 (Aspen)	18	8	26	9	39
3 (Doug-fir)	6	4	22	8	60
5 (Ponderosa)	41	7	7	18	27
6 (Pinyon)	44	20	2	5	29
13 (Spruce/fir on Landslides)	12	2	11	5	70

[1] Only the forested LTAs are shown
[2] This structure class contains the late-successional forest component

Table 3-26 displays the current structural-class distribution on the Forest It summarizes the information found in the LTA write-ups

The percentage of area in an undeveloped condition is useful in showing the relative amount of an LTA that would be subjected to natural processes Table 3-27 displays the amount of each LTA in an undeveloped condition This table summarizes the information found in the LTA write-ups

Table 3-27. Percent of LTA in an Undeveloped Condition

LANDTYPE ASSOCIATION											
1	13	2	3	4	5	6	7	8	9	10	12
60%	52%	50%	50%	87%	54%	24%	71%	30%	45%	43%	8%

Since the amount of motorized access is often directly associated with human presence, road and motorized-trail densities can be used as a good indicator of the amount of human disturbance in a particular area Density in and of itself is a limited parameter, because there is no spatial consideration It is impossible to judge how the roads or trails are placed in the area of consideration. are they clumped in one portion or evenly spread out?

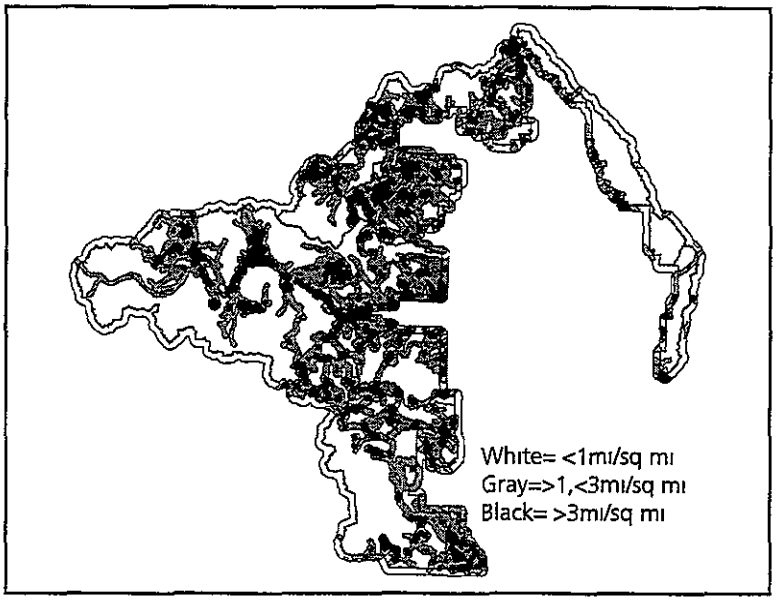


Figure 3-30 Road Density for all motorized roads and trails

To address this problem, a technique known as a "moving window analysis" was used (ARC-Focalsum) (Tribble 1996). This analysis focuses on a particular grid cell and the surrounding square mile (circular), assigns a value to that acre based on what is in the square-mile "window," then moves to the next cell and repeats the process. This is done over the area of consideration and shows, spatially, how the roads and trails are laid out There are two results shown one displays the total motorized routes (Fig 3-30, map of all roads and trails) and breakdown by LTA (Table 3-28, % of LTA by density category), and the other displays the roads that receive the vast majority (80+%) of the use (Fig 3-31, map w/out the 2-trackers and motorized trails; Table 3-29, % of LTA by density category)

Table 3-28. Percent of LTA by Road Density Category - all motorized roads and trails

Percent of LTA by Road Density Category												
	Land Type Association											
Density Category	1	13	2	3	4	5	6	7	8	9	10	12
<1 mi/sq mile	58	58	50	46	91	44	38	72	31	45	42	14
-2 mi/sq mile	30	25	38	39	8	42	51	27	46	40	42	62
>3 mi/sq mile	12	17	12	15	1	14	11	1	23	15	16	24

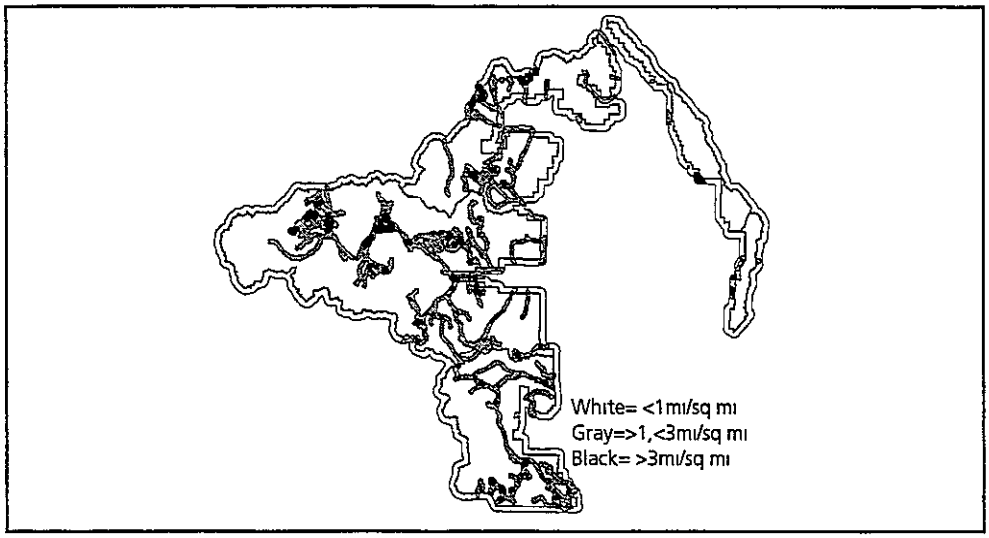


Figure 3-31. Road Density for primary roads only

Table 3-29 Percent of LTA by Road Density Category - primary roads only

Percent of LTA by Road Density Category												
	Land Type Association											
Density Category	1	13	2	3	4	5	6	7	8	9	10	12
<1 mi/sq mile	82	70	75	80	99	82	86	100	76	74	67	71
1-2mi/sq mile	16	23	24	18	1	17	14	0	20	23	29	28
>3 mi/sq mile	2	7	1	2	0	1	0	0	4	2	4	1

Closely associated with roads and trails is the amount of recreational use in an area Recreation activities can impact wildlife in a variety of ways, from direct mortality (hunting and fishing) to behavioral changes Boyle and Samson (1985) reviewed 166 studies that contained original data on the impacts of nonconsumptive recreation When categorized by type of activity and broad species groupings, 189 results were obtained Of these, 136 (72%) showed negative effects, 42 (22%) no/undetermined effects, and 11 (6%) positive effects.

On the Forest, the most popular types of recreational activities are driving for pleasure, hunting, fishing, camping, hiking, cross-country skiing, and snowmobiling Each of these activities has the potential to impact wildlife

Driving for pleasure includes both on- and off-road (trails) vehicular uses Numerous studies indicate that open-road densities can have an adverse impact on wildlife (Thomas 1979, Ward 1976, Kimball et al. 1979, Edge and Markum 1991, U.S Fish and Wildlife Service 1993) Most of the studies of this nature have been conducted on elk.

For people traveling on highways, especially in winter, it is hard to imagine that vehicles bother wildlife These people see a variety of wildlife which appear not to care that vehicles are speeding by. Some studies have shown that if the use is predictable (e.g., highway travel), some species become habituated to the activity (Dorrance et al 1975, Hicks and Elder 1979, Yarmology 1988, McLellan and Shakleton 1989, and U S Fish and Wildlife Service 1993). Any change in the predictable (e.g , stopping and getting out of the vehicle), however, does elicit a response

Some authors have found that elk were most disturbed by slow-moving, erratic, or noisy travel along secondary roads, especially by people getting in and out of their vehicle (Burbridge and Neff 1976, and Ward 1976) Kimbal et al (1979) felt that vehicle activity was more influential in displacing elk than the mere presence of the road Some authors feel that all open roads have the same impact, because there is no information indicating that low traffic levels are any less damaging than high traffic levels (Wisdom et al. 1986, Christensen et al 1993)

However, some studies indicate there is a correlation between levels of use and disturbance, with the higher the use, the greater the disturbance (Perry and Overly 1977, Kimball et al. 1979, Lyons 1983 and 1984, and Edge and Marcum 1991) In addition, Edge and Marcum (1991) showed that topography could help reduce the impacts of road use.

Hunting and fishing involve the direct mortality of wildlife A large proportion of the activity takes place near a road or trail (within a mile) Hunting can alter behavior, population structure, and distribution patterns, and unhunted populations function differently from hunted ones (Knight and Gutzwiller 1995).

Camping includes both developed campgrounds and dispersed campsites. The impacts here are alteration of habitat as a result of concentrated use, attraction of some species to the "free" food, and displacement of some species because of the noise and activity (Knight and Gutzwiller 1995).

On the Forest, hiking is tied primarily to trails, with few people striking off cross-country Some studies have shown that people walking about tend to elicit a greater response from wildlife than motorized disturbances (Freddy et al 1986, Knight and Gutzwiller 1995), and can displace species form the area during times the trails are in use Miller and Knight (1995) found a difference in avian-species composition and nest predation with respect to the distance from a trail The authors were not sure if this was a result of the trail itself, the heavy use (three million visitors per year in a area of about 27,500 acres), or a combination At the other end of the use spectrum, Gutzwiller (1994) looked at the effects human intrusion in an area might have on bird song occurrence. The study design was such that only one or two people would be in the area at one time. Except for one species, there was no consistent influence on song occurrence over the life of the study

Cross-country skiing on the Forest could be considered an intensive use, in that it is tied to specific areas (roads) As with hiking, the primary impact seems to be displacement from the area Aune (1981) studied the impacts of winter recreation in Yellowstone National Park and found that skiing caused a greater reaction than snowmobiling, especially when the skier-wildlife interaction occurred off the established trail In Canada, Ferguson and Keith (1982) found that skiing influenced the overwinter distribution of moose, but not elk Both species tended to move away from the heavily used ski trails They also found that

after the initial displacement from the onset of skiing on a trail, further use of that trail did not increase the displacement

Snowmobiling on the Forest is also an intensive use tied to specific areas For the most part, snowmobilers follow groomed tracks on top of roads to an opening, at which time they leave the trail and crisscross the opening Bury (1987) looked at a variety of studies on the impacts of snowmobiling, and concluded that in general, there was little effect on the larger species, moderate effects on medium-sized species (e g., rabbits, hares, foxes), and animals overwintering in subnivean spaces (under the snow) were drastically affected

Though LTAs are suitable for addressing habitat juxtaposition and potential habitats, they are weak when it comes to present vegetative conditions For this reason, an analysis of the dominant cover types is needed, to ensure that there are no obvious gaps in either spatial patterns or quantity of the existing situation

The spatial pattern parameter was chosen because it can be used to determine whether or not a particular habitat is well distributed across the landscape

RESOURCE PROTECTION MEASURES

Numerous protection measures have been developed for the proposed Alternatives They are primarily found in the Standards and Guidelines The most important ones are summarized here

The spatial-analysis guideline described in detail in the Fragmentation/Connectivity section will help to ensure quality habitat for the wildlife species on the Forest

A very important component of the *Endangered Species Act* and the Forest Service's Sensitive Species policy is the fact that prior to project implementation, another analysis will be done to further refine the potential impacts This will help ensure that impacts not detectable at the Forest level are considered

There are both general and species-specific Standards and Guidelines that will apply to the management of Threatened and Endangered or Sensitive species The Standards are general statements that are flexible in case new species are confirmed on the Forest, new species are listed, or new information is discovered The Guidelines are specific statements based on current knowledge of the species requirements They are Guidelines because there might need to be slight modifications based on local conditions

ENVIRONMENTAL CONSEQUENCES

The Biological Assessment made a finding of "no effect" for all Alternatives with respect to T&E species The Biological Evaluation made a determination of "may adversely impact individuals, but not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing or a loss of species viability rangewide" for all Alternatives with respect to Sensitive wildlife species In summary, the rationale was that ample potential habitat will remain regardless of Alternative Much of the habitat is in undeveloped areas,

which limits the risk of it being adversely altered by human activity (For a further analysis of these species consult Appendix G [Biological Assessment] and Appendix F [Biological Evaluation])

The grizzly bear and wolf were not part of the Biological Assessment because the USFWS does not recognize them as occurring on the RGNF. For this reason a determination of effect cannot be made. Because of the public interest in these species, however, a limited evaluation was done The evaluation is simply a discussion of how the Alternatives may affect any potential restoration efforts the USFWS might consider in the future.

Povilitis (1989) conducted an evaluation of the potential for the South San Juan area to support grizzly bears. His analysis area extended beyond the RGNF boundaries and took in portions of the San Juan and Carson National Forests. The evaluation included the vegetative cover of the area, potential food sources, livestock densities, land use patterns, and roads The author concluded that the area appeared capable of supporting grizzly bears.

None of the Alternatives will appreciably alter the situation as it existed during Povilitis's study The area will probably have an even lighter density of livestock grazing, as the number of permitted sheep continues to decline The density of open roads would remain about the same The small amount of proposed construction is offset somewhat by the amount of roads proposed to be restricted from motorized uses Consequently, no Alternative jeopardizes the habitat, precluding the potential restoration of grizzly bears.

In the event the presence of a grizzly bear is confirmed, an interagency contingency plan has been developed that outlines the short-term steps necessary to protect the bear A recent policy on "bear proofing" camping areas Forestwide was undertaken to reduce the conflicts between black bears and campers Its implementation will also reduce the potential of a grizzly bear-camper conflict Longer-term actions will depend on the Interagency Grizzly Bear Committee. The Committee will determine if the area should become a Recovery Zone and therefore a formal part of the Recovery Plan

None of the Alternatives alters the biological conditions that lead to the assumption that the RGNF could support 40 - 80 wolves (Bennett 1994) While some Alternatives result in more acres of Wilderness, none of them drops the amount below current levels There is no anticipated change in the numbers of deer and elk that inhabit the RGNF The density of livestock will probably be lower than it is today, based on the reduction in domestic sheep throughout the Forest Consequently, no Alternative jeopardizes the habitat, precluding a potential reintroduction of wolves

Management Indicators

(For a discussion of the consequences for riparian areas [the Willow/Sedge LTA], see the Water Resources section in this chapter)

As shown in Table 3-30 there was very little change in the makeup of the structure classes for LTAs 1 and 13 These two LTAs are combined because they both have spruce-fir as their potential vegetative cover type Only these two LTAs are displayed because the vast majority of the suitable timberlands (90+%) are located in them Because the other

forested LTAs would be subjected to very limited amounts of timber harvest, there would be no measurable changes in their respective structure-class makeups

The consequence of this is that there will be a very minor reduction in late-successional forest on the RGNF As a result, those species associated with late-successional forests will not be subject to a large change in their potential-habitat acreage

Table 3-30. *Acreage change in LTAs 1 and 13 by Structure Class*

ALTERNATIVE	STRUCTURE CLASS									
	1		2		3		4		5	
	Current 10% 95,890 Acres		Current 4% 39,000 Acres		Current 15% 140,853 Acres		Current 10% 90,670 Acres		Current 61% 580,190 Acres	
	Exp	Full	Exp	Full	Exp	Full	Exp	Full	Exp	Full
A	NC[1]	NC	NC	NC	NC	NC	NC	NC	NC	NC
B	1000	1000	NC	NC	NC	NC	1543	4000	-2543	-5000
D	980	1000	NC	NC	NC	NC	875	2922	-1855	-3922
E	986	1000	NC	NC	NC	NC	236	923	-1222	-1923
F	1000	1000	NC	NC	NC	NC	46	429	-1046	-1429
G	1000	1000	NC	NC	NC	NC	816	2156	-1816	-3156
NA	1000	1000	NC	NC	NC	NC	1114	2634	-2114	-3634

[1] No Change in the acreage

As Table 3-31 shows, there is a negligible change in the amount of undeveloped land for LTAs 1 and 13 The two LTAs were combined for the reasons explained above.

Consequently, there will remain large portions of various LTAs that will have little risk of being altered by human- caused disturbances Instead, natural disturbance processes will predominate in these areas

The number and density of snags on the Forest will continue to exceed the levels recommended for the two types of cavity nesters Any timber harvest activity must leave a minimum of two snags per acre, and an appropriate number of live trees

Table 3-31. Acreage reduction of LTAs 1 and 13 in an Undeveloped Condition

ALTERNATIVE	CURRENT 60% 575,070 Acres	
	BUDGET LEVEL	
	Experienced	Full
A	No Change	No Change
B	No Change	1085
D	No Change	558
E	No Change	No Change
F	No Change	No Change
G	No Change	295
NA	298	2412

that can maintain that level The large amount of undeveloped land will continue to provide a high density of snags that are naturally created.

This extensive acreage in undeveloped condition will also mitigate the potential effects of a rule change by the Occupational Safety and Health Administration (OSHA) The rule change calls for no work taking place within two tree lengths of a hazard tree "Hazard tree" is loosely defined, but could be interpreted to mean all snags If this strict interpretation is adopted, it could result in removing snags within timber harvest areas The consequence would be small pockets of the Forest without snags This situation would cause a loss of potential habitat. However, these areas would be small within the context of the Forest and be surrounded by the undeveloped areas that have high snag densities As a result, the impacts would be limited.

Motorized Access/Recreation

Knight and Gutzwiller (1995) present an up-to-date synthesis of what is known about the impacts and where our knowledge gaps exist They bring out some important points that need to be kept in mind when trying to describe the impacts from recreational activities:

* Wildlife have very few set responses to a particular type and/or timing of disturbance Their response is predicated on the previous kinds of experiences the individual species has with that disturbance This means that not only can the response vary from place to place, but also year to year, as new members are added to the population

* Although numerous studies of recreational impacts have been conducted, the knowledge gained is disparate and seldom definitive

* Some species move away from an area during the activity, but return once it is complete

* Several species seem to be tolerant of the noise generated by planes, cars, motorcycles, and snowmobiles, at a distance of one to two kilometers

The level of recreational use, and the patterns of that use, play an important part in defining the potential consequences for wildlife Currently the Forest's amount of use is low, compared to other Forests in the Province (Table 3-5) Of the roads used, about 75% of the use occurs on 15-20% of the road mileage For trails, five or six parties per day on a trail would constitute heavy use The use patterns point to tendencies to stay near existing roads and trails.

The hunting season is the time of year when the greatest amount of use occurs beyond the roads and trails, and is also the time when there can be off-trail use of ATVs to retrieve downed game. We suspect that initially, as the Forest's recreational use grows, the tendency will be that the areas seeing the use now will be used more, rather than new areas of heavy use developing After a period of time, the Forest would probably try to disperse the increased use to other areas, to reduce physical impacts With this as a context, the potential impacts of the most popular recreational activities are discussed below

Driving for Pleasure

The literature tells us that when the open-road density is greater than one mile/square mile, wildlife species experience increasing negative impacts (Theil 1985, Van Dyke et al 1986, Mech 1988, and U S Fish and Wildlife Service 1993)

There is no way to calculate the open-road and motorized-trail densities, since a travel-route inventory has not been completed An approximation was made by displaying two scenarios for the distribution of the motorized routes Figure 3-30 and Table 3-28 give the road densities for all the roads and motorized trails. This scenario overestimates the open-road density because.

* It includes many roads that are restricted from motorized use

* None of the 100 miles of road being proposed for motorized restrictions is included, since a separate analysis is needed and there is no way of knowing which ones will actually be restricted and when Because this would be Forestwide, there would be no real change in the map

* None of the proposed road construction is shown, since the exact locations are unknown This would not change the results any, since the amount of construction considered is so small

* The Saguache Ranger District's implementation of restricted motorized access on 82 miles of roads is not displayed, since the work has not been completed This could slightly reduce some of the higher-concentration areas, and would undoubtedly make a difference in the open-road density The northern part of the District is now undergoing a similar analysis, including the area around Cochetopa Pass

Figure 3-29 and Table 3-29 show the roads known to be open and the most-traveled roads This scenario underestimates the open-road density, since some of the roads are deleted that are in fact open to motorized uses

The situation with respect to open motorized routes lies between these two scenarios, probably closer to the former

For this analysis, we will assume that elk's reaction to road densities is similar to other wildlife species', because the only models that have tried to demonstrate a relationship between various road densities and wildlife have been for elk (Perry and Overly 1977, Thomas 1979, and Lyons 1983)

During big-game hunting season (roughly from the first part of October to mid-November), there is a dramatic increase in use of primitive roads and trails As a result, many of the roads and trails shown in Figure 3-30 receive some use As can be see, there are many areas where the densities exceed three miles per square mile Many of the LTAs have relatively high percentages in the high-density category (Table 3-29)

For the remainder of the year, the pattern of use is not nearly as extensive, and is reflected in Figure 3-31 As expected, there are fewer "hot spots" (areas with road density greater

than three miles/square mile), since the use on the primitive roads drops off considerably As seen in Table 3-30, many LTAs have a high percentage in the low-density category

Knight and Gutzwiller (1995) reported that the more frequent the disturbance, the greater the response to it There are no established thresholds, however, for what is "too much" disturbance This suggests that the heavily used roads could cause the greatest impacts But with those roads making up only a small percentage of the total, the impacts would be concentrated.

Another factor to consider is habituation of animals The keys seem to be that the activity be (1) predictable and (2) non-threatening

One way to attempt to make the activity predictable is to restrict use to roads and specific trails As a result of a Forestwide Standard, all cars and trucks are restricted to roads, in all but on Alternative B, ATVs and motorcycles are restricted to specific trails (see Travel Management section) In Alternative B, there would be an increase in the potential for disturbance, as some of the ATV/motorcycle use could become more extensive, increasing the likelihood of interactions with wildlife

ATV game retrieval is another exception During hunting season it is permissible to take an ATV off the trail to retrieve downed game. The offsetting factor here is that when this is permitted, there are numerous hunters in the woods As such, there is already a certain level of disturbance taking place, and it is doubtful the addition of an occasional ATV would add more disturbance than already exists

Knight and Gutzwiller (1995) reported that responses to disturbances are reduced when there is some sort of visual screening available This will be achieved through the implementation of a Forestwide Standard that will leave vegetative cover along roads

Though there are no ways to quantify the impacts, it appears reasonable to make some inferences from the literature During hunting season, it appears that a high degree of displacement and shifts in use patterns would occur in areas with a concentration of "hot spots " A concern is that this use is occurring during a time of year when animals are preparing for the winter months, and the amount of use might be precluding them from obtaining the necessary resources to survive the winter This would eventually reduce the fitness of the population, as mortality would be high and reproduction suppressed The only information available to address this concern is tied to the big-game species that are hunted In that information, there is no link between hunting pressure and population fitness One factor which could reduce the overall impact is that this period of heavy use is short—about six weeks.

During the rest of the year (except for winter, when snow obstructs travel over most of the roads and trails), the pattern of use suggests that there would be only small areas of the Forest where the densities would be high enough to cause problems with displacement and shifting patterns of use As explained above, there are Standards and Guidelines designed to reduce some of the impacts

As discussed earlier, for a time, as use on the Forest grows, the popular spots will become more popular But eventually, there will probably be an attempt to disperse the use into other areas As that happens, the use pattern will approach that shown in Figure 3-29,

resulting in more disturbance, and for a longer period of time than currently How much of an increase will depend on how successful the Ranger Districts are at analyzing travel-management concerns and pursuing motorized restrictions on some of the roads and trails.

Hunting and Fishing

Although these activities involve the direct mortality of animals (except in the case of catch-and-release fishing) only a few species are directly involved For these, the DOW manages the season and bag limits None of these populations show any evidence of adverse impacts from these activities The impacts on the unhunted species would be indirect and similar to those described for driving, camping, and hiking.

Camping

The impact from this activity is considered minimal, since the total acreage involved is very small and no major expansion of acreage is planned

Hiking

Although this could be one of the more disturbing activities, based on some of the studies, the light amount of use prevents it from being so There are many trails on the Forest that see very little traffic for days and weeks at a time As discussed above, even the heavily used trails do not receive all that much use The heaviest use, and the time most likely to cause an impact, is during hunting season Yet even then, the impacts would be somewhat limited, since the majority of hunters stay within a mile of the trails

Cross-Country Skiing

Based on the literature, the greatest chance of impacting wildlife is when skiers interact with wintering big game This impact is limited, since the wintering animals are in the lower country, which generally has poorer snow conditions and is not sought out by skiers.

Snowmobiling

As mentioned previously, the most impacted species are those that overwinter under the snow Given that snowmobilers crisscross the openings they come across off the trails, some species are probably impacted The total amount of area involved is small, however, since this type of activity occurs in only a few concentrated areas on the Forest

The fact that the use is primarily on groomed tracks is another factor which appears to lessen the impacts Aune (1981) found that snowmobiles caused less of a reaction on a groomed trail than in an area not generally used by snowmobilers

There is potential for impacts on wintering animals in the lower elevations In most years this is self-regulating, since the snow is not conducive to snowmobiling Nevertheless, much of the lower country on the Forest falls within Management Prescription 5 41, where snowmobile use is restricted to designated roads or trails.

The literature consistently states that direct harassment can elicit a very pronounced negative reaction in wildlife (Cooke 1980, Freddy et al. 1986, King and Workman 1986, McLellan and Shackleton 1989) There are some suggestions that harassment reduces the amount of time spent feeding, resulting in reduced fitness for the population Yarmology et al (1988) showed that mule deer deliberately harassed by an ATV had almost total reproductive failure

Currently, there are few reports of direct harassment of wildlife (e.g , chasing animals with an ATV or snowmobile) We cannot predict whether this type of harassment will increase in the future At best, we can say that as the Forest hosts more people, the risk increases

Knight and Gutzwiller (1995) outlined four categories of restrictions that may facilitate coexistence between recreationists and wildlife spatial, temporal, behavioral, and visual. All except behavioral are addressed to some degree by the Standards and Guidelines Since so little is known in this arena, a generic Standard was developed that allows the Forest to take action if it is determined that a particular disturbance is adversely impacting any TES species. This gives the necessary flexibility to make adjustments as new information is gathered The discussion below details how the Plan addresses these restriction categories

Spatial Restrictions

These would be situations in which access is denied to a particular area. For example, nesting raptors would be afforded a buffer zone around their nests that would preclude access during the nesting season. To protect bats, access to caves and abandoned mines would be controlled If, in the future, it is discovered that another TES species requires a buffer, the flexibility exists within the Standards and Guidelines to create one

Temporal Restrictions

The use of an area would be restricted during a critical time of the year For instance, much of the low-elevation portion of the Forest is within the Deer and Elk Winter Range Management Prescription (5 41), which restricts motorized travel in winter to designated roads and trails

Also, any oil and gas activity would be subjected to a timing limitation so that the activity would not take place during the winter The raptor-nesting buffer zone mentioned above could also be considered a temporal restriction, if needed in the future.

Behavioral Restrictions

This speaks to changing the behavior of the recreationist, and is outside the scope of the Plan The Forest has an aggressive environmental-education program, however, in which land stewardship ethics are discussed with a wide audience, from school children to campground visitors.

Visual Restrictions

As noted in the previous discussion on roads, researchers have found that wildlife appears to be less affected when visually shielded from human activities This is addressed by the

requirement to have adequate cover along roads kept open to human use and around openings Once again, there is flexibility for additional visual considerations

At current and projected levels of recreational use, and given the attempts to manage the potential impacts described above, there is no evidence to suggest that any particular species would be impacted to the point of calling its viability into question Knight and Gutzwiller (1995) point out that because most studies have focused on overt behavioral responses, there is very little information available that speaks to possible impacts at the population or community level They also bring up the fact that there is little information on cumulative impacts To try to address this shortcoming, the monitoring plan will track the populations or occurrences of selected TES species

Cover-Type Patterns and Quantity

As can be seen in Figures 3-32, 3-33, and 3-34, the spatial arrangement of the spruce/fir, aspen, and Douglas-fir cover types is fairly evenly spread across the Forest Because the other cover types make up such a small portion of the Forest, their spatial distribution is naturally scattered

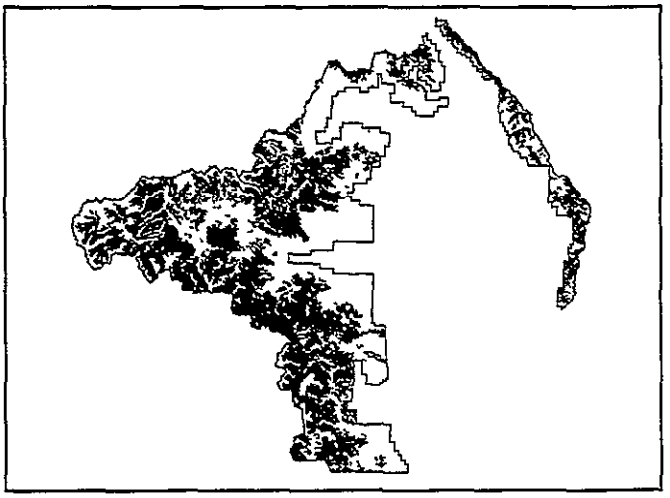


Figure 3-32 Spruce/Fir Distribution

The implications are that species associated with those cover types will not be isolated, or restricted to parts of the Forest The importance of this distribution is that the connectivity of the habitat will provide for easy dispersal across the cover types As stated earlier, one key to sustaining viable populations is the ability of the species to disperse to various patches of suitable habitat (The Fragmentation and Connectivity section provides a more thorough discussion of this topic)

Because of the problems associated with a viability analysis, there is no clear way of defining how much habitat, and what pattern, are necessary to sustain species. One known factor is that for many, if not most, of the species on the Forest, viability depends on habitat outside the Forest boundary

One way to assess the question of sufficient habitat on the Forest is to try to quantify how various cover types are currently distributed, and compare

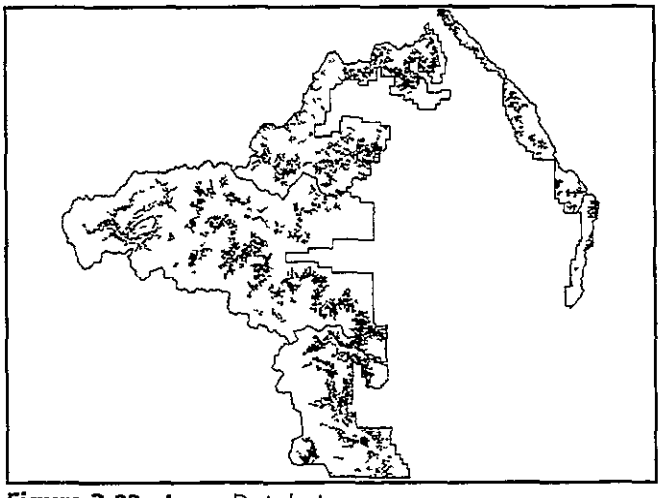


Figure 3-33 Aspen Distribution

them to some standard To accomplish this assessment, two different standards were used The first is an effort undertaken for this Forest Plan Revision, which targeted the spruce/fir and aspen cover types The second standard is the work done in Arizona and New Mexico on the northern goshawk, which focused on the mixed-conifer and ponderosa pine cover types

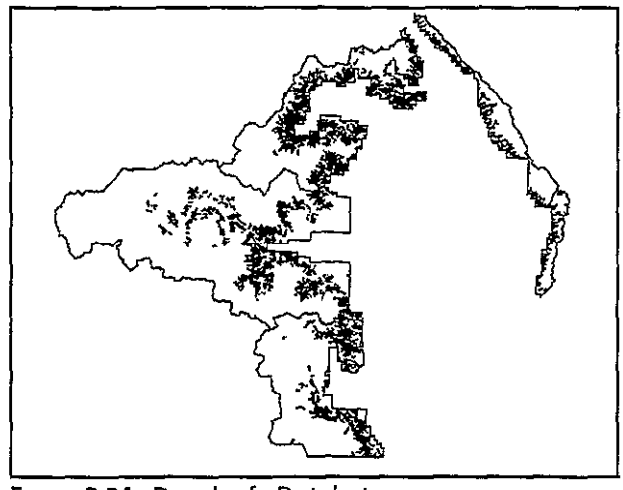


Figure 3-34 Douglas-fir Distribution

In an attempt to discover the "natural" distribution of spruce/fir and aspen across a landscape, a spatial analysis was undertaken for this Forest Plan Revision Basically, it entailed selecting a series of reference landscapes throughout LTA 1 that were assumed to represent "natural" conditions (Erhard et al 1996) Because there was no spatial analysis done for the other LTAs, it is assumed that the spatial values for LTA 1 are an approximation for the other LTAs where the cover types are found.

Care must also be taken in extrapolating the values, because the reference values are from sample sizes ranging up to 25,000 acres, and this effort will be comparing the values to a much larger area As a result, the values should be used only to make broad generalizations Figure 3-35 shows the relationship between the reference areas and the current situation for spruce/fir Figure 3-36 deals with aspen.

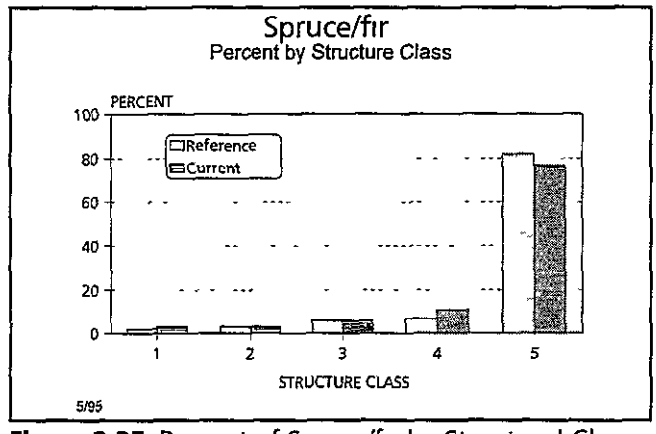


Figure 3-35. Percent of Spruce/fir by Structural Class

Taking into account the assumptions explained above, what the figures indicate is that each cover type can generally be said to simulate the distribution found in the reference areas This is significant because these reference areas are, in our opinion, the best representation of what "natural" conditions will be like for these two particular cover types. Based on this assumption, it could be argued that there are sufficient amounts of late-successional forest habitat for the species that use them This conclusion is based not on a particular species, but

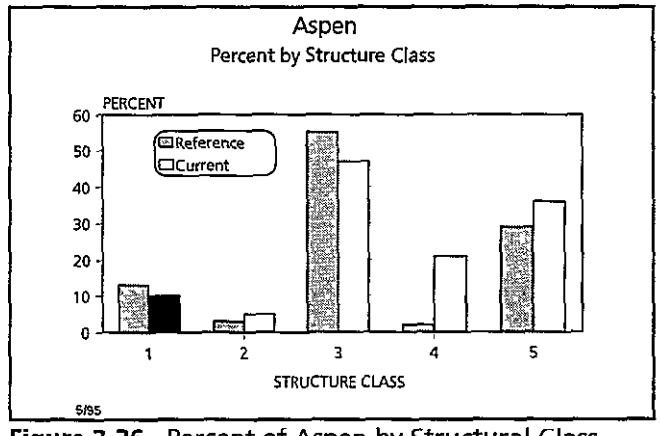


Figure 3-36. Percent of Aspen by Structural Class

on what a landscape in a "natural"condition could provide

A similar spatial analysis for Douglas-fir and ponderosa pine cover types was not conducted, for two reasons. First, the small amounts and scattered nature of these cover types made it very hard to find large undeveloped expanses (10,000+ acres) of these cover types Second, and more important, there was no way to tease out the impacts that fire suppression had on the spatial relationships

There has been some work done in Arizona and New Mexico with these cover types (Reynolds et al 1991) The focus of this work was how to manage for particular forest attributes that sustain goshawks While there are differences between the RGNF Douglas-fir and ponderosa pine cover types and where the study took place, the study's findings can still be used to make general comparisons

The goshawk study dealt with six different structural stages. The Forest uses five structural classes Another difference is that the trees studied grew to a larger size than they do on the Rio Grande

The study made recommendations regarding the distribution of the six structural stages across a landscape These recommendations were not related to goshawks or their prey, but were related to forest productivity, dynamics, and biological limitations (Graham et al 1993)

Table 3-32. Comparison between structural classes/stages

STRUCTURAL CLASSES	
STUDY	FOREST
1	1
2	1
3, 4	2, 3, & 4
5,6	5

Because of the different number of stages/classes used, some combining had to be done, to make a comparison with the Forest's data Table 3-32 shows how the combination was done The *recommended distribution (as expressed in the* Forest's structure classes) was compared to the current Douglas-fir and ponderosa pine distribution on the Forest (See Figure 3-37)

The numbers shown in Figure 3-37 suggest that the RGNF has ample amounts of late-successional forests The reason is that the study represents the upper end of the amount of late-successional forest one could realistically expect to find within these two cover types One could argue that the amount of late-successional forest currently on the landscape might not be sustainable Given their historically frequent disturbance processes, it is unlikely that a large build up of

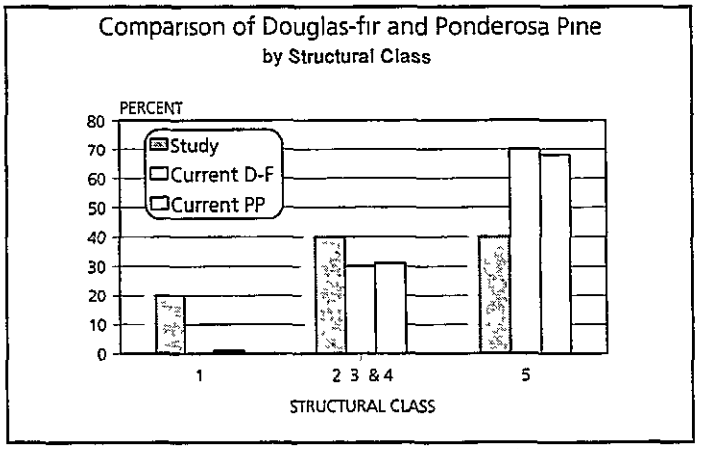


Figure 3-37. Comparison of Douglas-fir and Ponderosa Pine by Structural Class

late-successional forest could have occurred

RGNF Context Within the Tri-Section

Since population viability for wildlife depends on habitat outside the Forest boundary, there needs to be an analysis of that habitat.

As discussed in the Fragmentation and Connectivity section, the RPA map was used to obtain the forested cover types for the Tri-Section At this time, there are no comprehensive data that displays the entire Tri-Section's structure classes In addition, because of the resolution, the cross-walks between the cover-type classifications on and off the Forest are not necessarily compatible. Nevertheless, they are the best data we have for the area off the Forest, and will be used to assess the potential habitat there.

Table 3-33 displays how the acres of forest cover types on the RGNF fits within the totals for the Tri-Sections.

The table shows that the majority of each cover type lies outside the RGNF As discussed in the Province write-up, the majority of the cover types in the Region (and therefore, it is assumed, the Tri-Section) are 100 years old or older, and between one-third and one-half of the acreage could be considered to be in a late-successional condition One notable exception is ponderosa pine Most of it cannot be considered late-successional, because of earlier timber-harvesting activities. With only 3-5% of the cover type acres having potential for alteration within the next decade, the vast majority will not be subjected to human alteration

Table 3-33. Cover Types

COVER TYPE	TRI-SECTION	RGNF	DIFFERENCE
Fir-Spruce	2,395,200	561,300 (23%)	1,833,900
Douglas-fir	753,700	198,800 (26%)	554,900
Aspen [1]	688,200	260,900 (38%)	427,300
Ponderosa Pine	3,255,300	37,900 (1%)	3,217,400

[1] Combines the cover types aspen-birch and western hardwoods because by definition, the western hardwoods could include aspen The other species that could make up western hardwoods (e g , cottonwoods) were felt to be a minor component, and most of those classified acres were probably aspen

Of course, there is always the chance that a natural disturbance could alter many thousands of acres Consequently, except for ponderosa pine, there should be large acreages of late-successional forest habitat available in the Tri-Section area. Probably the current lack of late-successional ponderosa pine forest has greatly affected species associated with it We anticipate, however, that the amount of late-successional forest should increase, given the small amount of potential harvest within the Tri-Section

More important, the table illustrates that how spruce-fir, Douglas-fir, and aspen are managed on the RGNF can have a large influence on the entire Tri-Section area The result is that the RGNF plays a large role in the viability of those species associated with these particular cover types Conversely, with only 1% of the Tri-Section's ponderosa pine, the RGNF plays a very minor role in the viability of species associated with ponderosa pine.

Spatially, there does not appear to be any obvious clumping that suggests a species will be restricted to only part of the Tri-Section

CUMULATIVE EFFECTS

The risk to species viability from any of the Alternatives is considered small, for the following reasons

* There is no adverse impact on the Threatened, Endangered, or Sensitive wildlife species.
* The Forest has ample amounts of late-successional forest habitat compared to the cover-type standards, which were based on forest dynamics, productivity, and biological limitations
* The habitat on the Forest will remain well distributed
* There are no known barriers that will prevent species from using the habitat within the Forest
* A large portion of the Forest will remain in an undeveloped state, where natural disturbance processes dominate
* The five potential corridors that connect the Forest to its surroundings (see the Fragmentation and Connectivity section for details) will not be altered to prevent species movement
* Large amounts of late-successional forest habitat will remain outside the Forest boundary
* The habitat beyond the Forest boundary is well distributed

Old-Growth Forests

ABSTRACT

Old-growth forests are unique ecosystems that are an important part of biological diversity Baseline conditions of pre-settlement old-growth composition, structure, and pattern on the landscape do not exist The Forest does not have an inventory of old growth according to Mehl's (1992) criteria, so an approximation is used called "late-successional forest " There are 701,464 acres of late-successional forest on the RGNF Timber harvest could potentially reduce old-growth acreage by 14,640 (2 1%), 0, 23,340 (3 3%), 16,606 (2 4%), 12,714 (1 8%), 5,548 (0 8%), and 15,938 (2 3%) acres per year under experienced budget levels for Alternatives NA, A, B, D, E, F, and G, respectively The majority of the forested landscapes on the RGNF would continue a natural course of growing, dying, and regenerating. As the

Forest becomes older, there is an increased probability of a high-intensity fire or insect and disease epidemic

INTRODUCTION

Old growth means different things to different people For instance, some people value old growth for its structural attributes (e g , down logs)—particularly as they apply to wildlife habitats Others view old growth from a spiritual perspective Finally, others view old growth ecologically—as an important advanced stage in ecological succession. All of these ideas are valid perspectives. However, our discussion will focus more on the ecological nature of old growth.

According to Mehl (1992), old-growth forests are unique ecosystems that are an important part of biological diversity Old growth occurs later in a stand's development A stand in an old-growth condition has developed a diversity of functions and interactions that do not exist in earlier stages The later stages differ from earlier stages by structure, such as tree size, standing and down dead trees, number of canopy levels, age, and type of understory

The age at which old growth develops and the structural attributes that characterize it vary by species, climate, site conditions, and past disturbances However, old growth is typically distinguished by several of the following stand attributes

* large trees for the species and site,
* variation in tree sizes and spacing;
* standing and down dead trees,
* decadence, in the form of broken or deformed tops or bole and root decay,
* multiple-canopy layers; or
* gaps in the tree canopy and understory patchiness

A stand may contain some trees that meet the criteria for old growth but as a whole might lack the functions and interactions of an old-growth ecosystem, and therefore would not be considered old growth

Different old-growth stages or qualities are recognizable in many forest cover types. Sporadic, low- to moderate-severity disturbances are an integral part of the internal dynamics of many old-growth ecosystems Canopy openings resulting from the death of overstory trees often give rise to patches of small trees, shrubs, and herbs in the understory Frequent, low-intensity fires are important for some species to maintain their dominance on a site

Old growth is not necessarily "virgin" or "primeval." Some feel that it could develop following human disturbances Some also feel that it could develop from humans' indirect influence on the landscape by the control of fire Table 3-34 shows the attributes used to describe old growth in the Rocky Mountain Region

The minimum criteria for the structural attributes used to determine old growth are those that add a quality characteristic Attributes with an "X" or a numerical value are considered "must" criteria Those with a "Q" are quality criteria The quality attributes are not required for old growth, but contribute to higher-quality old growth if present Any of the "must"

criteria in excess of the minimums could also indicate a higher quality of old growth (Mehl 1992)

Table 3- 34. Old-Growth Structural Attributes/Quality Attachments

STANDARD ATTRIBUTES	FOREST COVER TYPES					
	Spruce/ Fir	Douglas-Fir	Lodgepole Pine	Ponderosa Pine	Aspen	Pinyon-Juniper
Live Trees—Upper Canopy						
DBH/DRC [1/]	16	18	10	18	14	12
Trees/Acre	10	10	10	10	20	30
Age	200	200	150	160	100	200
Diameter Variation	X	X		X	Q	X
Decadence	X	X	X	X	X	X
Multiple-Canopy Layers	X	Q	Q		Q	
Dead Trees—Standing						
DBH/DRC [1]	10	10	8	10	10	10
Trees/Acre	2	2	2	2	Q	1
Dead Trees—Down						
Pieces/Acre	X	X	X	Q	Q	2
Additional/Qualities Attributes						
Slow-Growing (Main Canopy)	X	X	X	X	X	
Canopy Closure 50% Plus					X	
Canopy Closure 35% Plus						X
Wide Range of Vigor	Q	X				
Net Growth Near Zero	X		Q	Q		
Patchiness	X	Q	Q			
Many Stages of Decomposition	X		Q	X		
Multiple-Tree Species			Q		Q	
Distinctive Bark	Q			Q		
Distinctive Crowns			Q	Q		

[1] DBH = Diameter at Breast Height DRC = Diameter at Root Collar (applicable only to pinyon/juniper)

Kaufmann et al (1992) clearly articulated how little is known about old-growth forests and posed the following questions

- How much old-growth is enough?
- Is the proportion of old growth higher in some Landtype Associations (LTAs) than others?
- How large should old-growth stands be?
- Are the concepts of old-growth distribution and connective corridors useful in a naturally fragmented landscape?
- What was the pre-settlement pattern of successional stages for each LTA?
- How has fire suppression (or other broad-scale changes) this century affected old growth?
- What is the role of old growth in the eventual development of subsequent forests on a site?

They noted that these important management questions are also important research questions that are unanswered

Old growth may be the preferred habitat for specialized mosses, fungi, microbes, and higher plants (Romme et al 1992). Older forests are known to be preferred habitat for a number of vertebrate species, such as flammulated owls (Reynolds and Linkhart 1992) and martens However, species found in older forests are often found in other types of habitats. So the absolute importance of and dependence on old growth to a species is often unclear

The diversity of old-growth forests is greatly attributed to fungi, bacteria, and other microorganisms This portion of the biological community is poorly understood, yet extremely rich Wilson (1993) suggests that there are several thousand species of bacteria in a single pinch of forest soil. This fundamental portion of the food chain undoubtedly supports an abundance of inconspicuous invertebrates (animals without backbones) Many small mammals consume fungi, and their fecal pellets may serve an important role in recycling nutrients and inoculating germinating plants with mycelium (the vegetative body of fungi that often helps plant roots extract more water and nutrients) (Maser 1988). The complexity and interdependency of food chains become apparent when insects (for example, ants, bees, and wasps) and larger animals (for example, woodpeckers and bears) are considered

Research by Kaufmann (1992) suggests that trees growing rapidly early in their life approach old-growth conditions sooner than trees that grow more slowly in their early life. Thus the stand's period of old growth is extended This means that it may be possible for people to intervene purposefully early in a stand's development and have a significant influence on its eventual old-growth characteristics Conceptually, careful treatment could

improve the longevity of old-growth stands Obviously many factors, including site, climate, and natural disturbances make it difficult to predict when and for how long a stand will be old growth

It would be ideal to develop a baseline of old-growth conditions based on pre-settlement conditions (Covington and Moore 1992) Yet pre-settlement conditions are probably unattainable There has been an order-of-magnitude increase in atmospheric pollutants into forest ecosystems since the Industrial Revolution. There has been a 40% increase in atmospheric carbon dioxide since the mid-1800s, which may have far-reaching impacts on the growth and longevity of old-growth stands (Kaufmann et al 1992) Consequently, there are no unimpacted old-growth stands. Going back to a pristine, presettlement condition is not possible This means that decisions to do something or nothing to old growth will have to be made without having a precise reference It may be more important to get a clear understanding of how much change has occurred since settlement and decide what they mean today.

The Forest does not have an inventory of old growth according to Mehl's (1992) criteria However, we do estimate of the amount of late-successional forest Late-successional forests are defined here as Structure Class 5 (see description of Landtype Associations, narrative discussing Structure, presented earlier in this Chapter). The acres of late-successional forest are an approximation of the Forest's old growth (See the Fragmentation and Connectivity section in this Chapter for a discussion of how animal species use Structure Class.)

AFFECTED ENVIRONMENT

There are about 701,464 acres of late-successional forest on the RGNF This is 59% of the forested land base and almost 38% of the Forest's total land base These acres can be presented in greater detail by Landtype Association (LTA) Table 3-35 is a summary of late-successional forest acres by LTA

Table 3-35. Forested LTA Acres, Percent of Total Land Base, Acres of Late-Successional Forest, and Percent of LTA.

LTA	ACRES	% OF TOTAL AC ON FOREST	ACRES OF LATE-SUCCESSIONAL FOREST [1]	PERCENT OF LTA
Engelmann Spruce on Mountain Slopes	924,045	50	553,961	60
Aspen on Mountain Slopes	39,937	2	15,344	38
White Fir and Douglas-fir on Mountain Slopes	94,433	5	56,036	59
Ponderosa Pine and Douglas-fir on Mountain Slopes	102,240	6	25,724	25
Pinyon on Mountain Slopes	85,320	5	24,169	28
Engelmann Spruce on Landslides	37,806	2	26,230	69
TOTALS	**1,283,781**		**701,464**	

[1] Late-Successional Forest = Structure Class 5 = Habitat Structural Stages 4b, 4c, and 5

The majority of late-successional forest is in the Engelmann Spruce on Mountain Slopes LTA (LTA1). Based on an analysis of RGNF roadless areas (areas with limited human alteration of the vegetation), roughly half of LTA1 should be in spruce cover type, late-successional forest. The Forest, as a whole for LTA1, actually contains a greater amount of spruce cover type in late-successional forest

The amount of late-successional forest that should be expected in other LTAs is less clear. Based on range-of-natural-variability analysis and Province-level analysis, however, the implication is that the Forest's trees are in a relatively older condition. Without reliable data on pre-settlement old growth amounts (both upper limit and lower limit) by LTA, it is

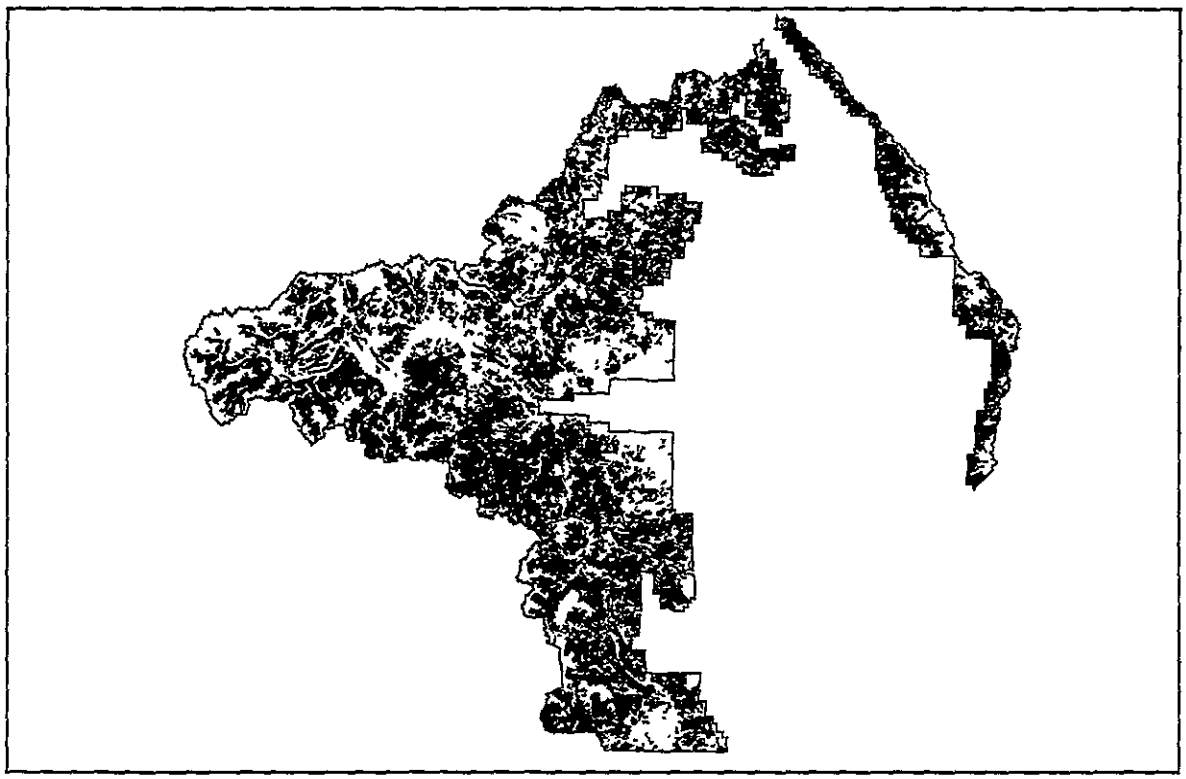


Figure 3-38. Late Successional forest stands on the RGNF

difficult to quantify appropriate amounts Perhaps, then, it becomes important to assess the actual risks of old-growth loss that each LTA will experience, by Alternative

Figure 3-38 shows the spatial arrangement and extent of late-successional forests on the RGNF.

RESOURCE PROTECTION MEASURES

There is a Forestwide Standard and Guideline which addresses the preservation of potential and existing old growth. Project environmental analysis will incorporate old-growth size and landscape configuration into project design

The Forest Interdisciplinary Team considered using an old-growth Management-Area Prescription The Team felt that there was insufficient information to allocate the Management-area Prescription comprehensively across the Forest There was also concern that the criteria defining old growth could change in the near future This could quickly make the allocations obsolete The Team felt that it would be difficult to reach agreement, both internally and externally, on the spatial allocation of an old growth Management-Area Prescription under current knowledge

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

This analysis presents a context of how much of the Forest's late-successional forest could be altered in the next ten years This should help display a risk to old-growth forests, by Alternative. (Also see the TES/Viability section in this Chapter, where an evaluation of LTA Structure Class changes is shown by Alternative)

Table 3-36 shows the percentage of land where management-activity intensity increases by Alternative Management Emphasis Categories 1 through 8 represent a range of landscapes, from those unmodified by humans to very modified landscapes

Categories one through four were separated from the other categories because they have relatively low potential for allowing direct human alteration of vegetation Alternative F has the least potential likelihood of altering the Forest, Alternative NA has the most

Table 3-36. Percentage of Land Allocated by Management Emphasis Category and Alternative .

MANAGEMENT EMPHASIS & DESCRIPTION [1]	ALTERNATIVE						
	NA	A	B	D	E	F	G
Category 1—Ecological Processes dominate	25	51	28	38	42	58	22
Category 2-- Conservation of representative/rare ecological settings	0	<1	<1	<1	<1	<1	<1
Category 3—Ecological settings w/ minimal human use	4	5	7	6	8	14	26
Category 4—Ecological values w/ recreation-oriented use	<1	7	5	6	5	5	6
SUBTOTAL	**29%**	**63%**	**40%**	**50%**	**55%**	**78%**	**54%**
Category 5—Forested ecosystems managed for a variety of needs	51	32	50	41	37	17	37
Category 6—Grassland ecosystems managed for a variety of needs	14	<1	4	4	2	0	4
Category 7—Intermingled lands	0	0	0	0	0	0	0
Category 8—Ecological alterations are permanent	<1	<1	<1	<1	<1	<1	<1
Private	5	5	5	5	5	5	5
SUBTOTAL	**71%**	**37%**	**60%**	**50%**	**45%**	**22%**	**46%**
GRANDTOTAL	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**

[1] Categories shown in order of increasing potential modification to the landscape

Effects on Old Growth from Timber Management

Harvesting old-growth stands results in a direct reduction in acres The severity of impact on old-growth stands varies depending on the type of timber harvest For example, a clearcut harvest would obviously have a strong influence on old-growth ecological dynamics (and certainly the stand's appearance). On the other hand, an individual-tree-selection harvest (where scattered, individual trees are removed) could leave a stand relatively intact Table 3-37 shows the acres potentially harvested, by Alternative.

Table 3-37. Acres Potentially Harvested in the First Decade by Alternative and by Budget Level

	ALTERNATIVE						
	A	B	D	E	F	G	NA
Full Budget							
Acres potentially harvested	0	55,036	38,759	24,360	17,159	38,104	39,542
Approx percent of harvest from LTA 1 or 13	0%	89%	90%	89%	84%	90%	89%
Experienced Budget							
Acres potentially harvested	0	23,340	16,606	12,714	5,548	15,938	14,640
Approx percent of harvest from LTA1 or 13	0%	94%	94%	94%	93%	95%	93%

Regardless of budget, none of the Alternatives poses a significant risk to late-successional forests In the full and experienced budget scenarios, the acreage affected is highest in Alternative B and lowest in Alternative A Most of the potential harvest occurs in spruce-dominated LTAs (LTA 1 or 13)

Effects on Old Growth from Mineral Exploration and Extraction

Mineral activity on the Forest is projected to be relatively low for locatable, leasable, and salable minerals. The total disturbance is projected to be 219 acres in Alternatives NA, B, D, E, and G The total disturbance in Alternatives A and F is only 69 acres The magnitude of this disturbance on late-successional forests (at most 219 acres out of 701,464) is insignificant

Effects on Old Growth from Travel Management

Oil and gas development and hard rock mining propose an estimated 21 5 miles of new road construction, by Alternative, at both full and experienced budgets Roads associated with timber harvest activity in Alternatives NA and B propose 49 miles and 64 miles of new roads, respectively, for the first decade at full budget. At experienced budget levels, the road mileage is 1 mile and 3 miles in Alternatives NA and B, respectively In all other Alternatives, it is less The locations of proposed roads are unknown, since mileage is based on estimated timber volume harvested, estimated oil and gas development, and estimated hard rock mining development, by Alternative This level of disturbance is insignificant on late-successional forests

CUMULATIVE EFFECTS

There has been an order-of-magnitude increase in atmospheric pollutants into forest ecosystems with the Industrial Revolution. There has been a 40% increase in atmospheric carbon dioxide since the mid-1800s, which may have far-reaching impacts on the growth and longevity of old-growth stands (Kaufmann et al 1992)

The majority of the RGNF's forested acreage is late-successional forest In the future, as the acres of older forests increases, there could be an increased incidence of high-intensity fires or insect and disease epidemics